SATURDAY, OCTOBER 13, 1923.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.
Editorial communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

A Representative Body for Science.

FROM time to time proposals have been made for the establishment of a body representative of British scientific opinion—professional or otherwise; and various opinions have been expressed as to the constitution and functions of a body of this kind. It seems desirable, therefore, to consider some of the questions raised by these proposals.

First it may be asked whether such a body does not exist already. A fully representative body is one which can recommend a course of action in the perfect assurance that its recommendation will be accepted by all but an insignificant minority of its constituents. There are bodies representative in this sense of some groups of scientific workers; there are others which, in the opinion of their members, should be, or some day may become, fully representative. But there does not seem to be any body which actually possesses at the present time the necessary authority over all scientific workers.

The second question is whether there is such a thing as scientific opinion, of which any body can be representative. The opinion relevant to our discussion is not that concerning technically scientific matters. Such opinion is not formed in council, and needs no enforcement, even among the laity. The only matters on which a representative scientific body could usefully express an opinion are those on which the laity judge for themselves, and are not always prepared to accept the verdict of scientific workers. For our purpose there is no scientific opinion unless there are questions on which scientific workers, while agreeing substantially among themselves, are apt to differ from important sections of the rest of the community. There probably are such questions; for example, there is the recognition, economic, political, and social, to be given to scientific work. Other matters need not be mentioned; but, since our judgment of the desirability or possibility of a representative body is likely to be greatly affected by our view of the nature of the problems with which it will have to deal, every one who discusses the matter should start by suggesting to himself concrete examples of such problems.

Supposing, then, that it is decided that there is a group of problems on which a definite scientific opinion exists, we may proceed to inquire whether it is likely that any actual representative body would succeed in expressing it. If there is any doubt on this matter, it will probably arise from a fear that any body of the kind proposed would be sure to lose touch with the average scientific worker and fall under the domination of some unrepresentative clique. The danger must be recognised, for scientific workers are often not highly endowed with the "political sense." Methods of avoiding it will be considered later; but here it may be pointed out that an undue insistence on the danger may defeat its purpose. It is fatal to assume at the outset that the body is going to fall into the hands of a clique; many promising organisations (not necessarily in the scientific world) have failed to express the general will merely because a large section of the community, seeing among its original promoters some persons with whom they disagree, have overlooked the presence of others with whom they do agree and have refused to join it. Further, it must be remembered that, if there is not perfect unanimity, the minority is sure to accuse the majority of being dominated by a clique; it always does. Every political party, for example, when it is really in a minority, always maintains that the nation is being led astray by some small band of evilly disposed persons.

Next, if there is a scientific opinion which can be expressed by a representative body, could it be enforced? Here any discussion would probably turn on the analogy of bodies representative of other professions, such as lawyers, teachers, or doctors. The analogy suggests that the outlook is promising, but the differences as well as the resemblances should be noted. Men of science form a much less homogeneous body than any of these three professions; moreover, the laity is, or was until quite recently, much less firmly convinced of the need for the profession at all. However, this is not the objection usually raised on this score; it is sometimes suggested that a representative scientific body, though it might exercise great influence, could attain its ends only by means of some coercion on its own members or the outside public, which is intrinsically undesirable. To those who do not believe that all interference with the action of others is illegitimate it may be suggested that "coercion" is a relative term. Most people use the term only when they object to the ends to which the proposed "coercion" is directed; they seldom shrink from any form of pressure which is unavoidable if ends are to be attained in the justice of which they believe firmly. Objection on this score is usually closely associated with the fear of a dominant and hostile clique.

These simple considerations suggest others concerning the constitution of a representative body. To-day all will probably agree that its constitution must be "democratic," that its constituents must include all who have any right to be termed scientific workers (and nobody else), and that each constituent must have equal voting power in determining its policy. But that is not enough; the constituents must be real and active, and must take a constant interest in the body supposed to represent them. This result will probably not be achieved if all representation is indirect, and the selection of the council (for some kind of council is clearly necessary) lies in the hands of subsidiary bodies appointed by direct election; such indirect election will be all the less satisfactory, if those subsidiary bodies are selected primarily for some other purpose. This point is important, because one method by which a representative body might be established would be by some kind of federation of existing organisations, such as the professional institutes. While it will probably be necessary, as well as desirable, that the institutes should be given a constitutional relation to any general representative council, we doubt whether a council based solely on such bodies would remain sufficiently closely in contact with all shades of scientific opinion. A considerable proportion of the "franchise" must surely be direct; and even that part which is indirect should take into account as many and diverse classifications of the scientific community. Even in the initial stages, which lead up to the establishment of the representative body, direct expression of opinion should be encouraged. We think that no steps should be taken until the proposals have been fully discussed either at meetings or in the columns of scientific journals.

But no franchise, however perfectly designed, can secure the continual interest which is the sole guarantee of true representation. The representative body must have some work to do which will affect every constituent and make it impossible for any one to remain indifferent. This work need not necessarily concern matters on which there is likely to be general agreement, and on which it is proposed that the body shall make a pronouncement of scientific opinion to the outside world; indeed, any pronouncement which the body may make with substantial unanimity will have much greater force if it is known that on other matters of internal moment there is no sign of unanimity. The body must not seek to secure an undisturbed atmosphere of philosophic calm; it must handle controversial issues, because they alone are vitally interesting.

Here is the gravest problem; for if any controversial issue is recognised from the start as within the scope of the body, those who think they will be in a minority on that issue will try to hinder its establishment, and will undoubtedly succeed. We would, therefore, put forward a concrete suggestion. It is that, at the outset, the body should direct its attention to one problem only, namely, to the establishment of a register of qualified scientific workers. The problem will have to be solved if the body is to be called into existence; it raises difficult questions on which almost every one has some opinion; but the controversies that are likely to arise in its discussion will not necessarily be fatal. They are not likely to be bitterly personal; for at the start all questions will concern classes and not individuals; it is sure to be recognised that individuals already existing are given the benefit of every possible doubt. Again, minorities are likely to resent exclusion rather than inclusion; the hostility of a minority whom it is proposed to exclude is clearly not so important as that of one which, by its secession, can ruin the scheme. Further, a registering body would probably have little difficulty in securing immediately some official position and recognition. These reasons seem to point clearly to registration as the first task of the representative body; but, since registration in science is not a matter of primary importance, we would make it clear that we do not think it worth while to establish a registering body unless it is understood that, when this part of its work is concluded, it is to develop wider activities.

Synthetic Colouring Matters.

Synthetic Colouring Matters: Dye-stuffs derived from Pyridine, Quinoline, Acridine and Xanthene. By Prof. J. T. Hewitt. (Monographs on Industrial Chemistry.) Pp. xi+405. (London: Longmans, Green and Co., 1922.) 14*s.* net.

IT is probable that when the monographs on colouring matters which are promised in the introductory note to Sir Edward Thorpe's series on industrial chemistry have been published, they will represent as complete a compilation of the essential facts as exist in any language. Moreover, they will probably form a convenient source from which those who wish to obtain full information on this important branch of organic chemistry can readily do so without having to spend time and energy in consulting such cumbersome literature as that of the *Fortschritte*. The first volume to appear, that on the "Natural Colouring Matters," by Perkin and Everest, is already known and appreciated by chemists, and we have now to look forward to the publication of no less than six volumes on synthetic colouring matters by authors who should know what they are writing about. The first of these volumes to appear has the title given at the head of this review, and sets a standard which augurs well for the success of the series.

Probably few books are more difficult to write (or to read) than those which deal with a highly specialised and commercialised branch of science, such as that which includes the synthetic colours. It would not be so bad if scientific literature alone had to be summarised, because in that case the author's task of discriminating between fact and fable would be reduced to a minimum. With the synthetic colours, however, much of the grain is hidden under the mass of chaff which constitutes the patent literature, and the difficulties of winnowing are great. It is difficult to understand why so much money and energy are devoted to the collation of chemical patent literature when, as most people know, much of it is untrue and a great deal of the remainder misleading. Chemical patent literature is, and always has been, and probably always will be, written by lawyers for lawyers; and it will probably always be the case, in spite of restrictive legislation, that the manufacturing firms concerned will often be inclined to place no small value on any publication which tends to mislead their competitors, and where some is false all must be suspect. Still, in many cases, the sole source of information respecting the synthetic colours lies in the patent literature and, in consequence, an author has to exercise a wise discretion in sifting and arranging all the material which comes to his hand. It follows, therefore, that the possession of a wide knowledge, not only of his subject but also of the technique of his subject, is essential if the result is to be in any way comparable with the energy expended, and, probably, no one is more fitted than the author of this work—an old and honoured worker in many of the fields he describes—to undertake the task he has accomplished so admirably.

Prof. Hewitt's work is a readable book, although it contains a mass of complex information, and its readability is due to the manner in which the author has summarised and, in some cases, criticised the material he has collected. His criticism is, however, neither carping nor hostile, but is always expressed in a detached and almost humorous manner, which is so characteristic that it cannot fail to raise a smile upon the lips of those to whom he is personally known.

Although originally intended to be a book on the acridine and xanthene colouring matters, it was ultimately found necessary to include those derived from pyridine and quinoline, and the first four chapters are devoted to a description of these bases and the colours obtained from them. It is perhaps fortunate that the change was made, because it enabled the author to include a description of the cyanine group, many members of which are important photographic sensitising dye-stuffs. The next five chapters are devoted to the acridine derivatives and contain an exhaustive account of these colouring matters. Chapter x. deals with the pyrone ring, and introduces the history and description of the oxonium salts. The subject-matter of this chapter naturally leads to a description of the colouring principles of flowers, but one finds, with some regret, that there the author breaks off and refers the reader to the previous monograph by Perkin and Everest. Surely a little overlapping in this series of monographs is not only inevitable but desirable. The remaining chapters give interesting accounts of the pyronines and rosamines; the constitution of fluorescein and analogous compounds; the constitution of the rhodamines and their manufacture; and the chemistry of the rhodols and anisolines. Of special interest, from the general point of view, is the discussion of the constitution of phenolphthalein and fluorescein, which is given in a manner which will appeal to those students who have to approach these difficult problems for the first time.

The book is well printed and the very complex formulæ are particularly clear and easy to follow. It is stated to have been printed in Saxony, and this probably accounts for some of the quaint spelling which has escaped the vigilance of the proof-reader. "Recomends" on p. 11, "wather-bath" on p. 29, the inverted commas on p. 66, "occour" on p. 289, "preapare" on p. 269, "doubtfoul" on p. 38, "ac" on p. 56, "annother" on p. 58, "occurence" on p. 64, "alo" on p. 91, and "accridine" on p. 120 meet the eye and are perhaps inevitable in the circumstances. Moreover, it is difficult to know what the "dashes" after the names of Williams and Hofmann on p. 55 really mean. But these are minor faults, and both the author and the editor are to be congratulated on the production of a volume which will long remain the standard treatise on the subject with which it deals.

J. F. THORPE.

The Eye and Vision.

The Present Status of Visual Science. By Dr. Leonard Thompson Troland. Pp. 120. (Bulletin of the National Research Council. Vol. 5, Part 2, No. 27.) (Washington: National Academy of Sciences, 1922.) 1.50 dollars.

THE eye can be regarded as holding a unique position among the organs of special sensation, because of all methods of observation, those carried out by vision, either unaided or through the medium of suitable accessory apparatus (*e.g.* the photographic plate), are the most accurate, rapid, and susceptible of the widest application. Moreover, the problems which the eye presents for solution are of interest, not only to the physiologist and anatomist, but also to the oculist, physicist, psychologist, and the illuminating engineer, and much has therefore been written by them in their own respective spheres. So plentiful, in fact, has the literature of vision become, that a complete mastery of the subject is possible to few. Dr. Troland has therefore achieved a result of great value in the publication of the book before us.

Early in the book, and again in the concluding pages, Dr. Troland utters a word of warning; there are, he points out, too many papers published on vision. Many authors, he says, "show a lack of acquaintance with the problems and results with which the others are concerned" (p. 10), and "appear also to have a profound contempt for existing literature, even when it is in their own language" (p. 110). In many papers there is "an absence of that complete specification of all circumstances surrounding experimentation which is needed to render the results of any permanent value" (p. 110).

The reader of Dr. Troland's book will find that the pages which follow the introduction are written with three objects in view: to indicate as clearly as possible the lines of cleavage between the physiological, psychological, and physical aspects of vision; to summarise the well-established facts concerning the various mechanisms associated together in the eye; and to indicate the points where our knowledge is defective or altogether absent. Owing to the necessity for brevity it is not possible to go over all three parts of Dr. Troland's book in this review. The last one will alone be selected for detailed consideration, because it recalls some of the well-established facts of vision at the same time that it indicates the direction which future research should take.

Considering, in the first place, those eye structures which co-operate to form an image on a retina, Dr. Troland writes (p. 39): "The ophthalmoscope, the skiascope, and the corneal microscope (supplemented by Gullstrand's slit-lamp) provide us with instruments for examining the tissues of the living eye in a very satisfactory way." Elsewhere he adds (p. 40): "Helmholtz was able to work out satisfactorily the main dioptric or refractive function of the eye from data of optical anatomy, in combination with the established general principles of physical optics." The word "satisfactorily" in the above sentence unfortunately cannot pass unchallenged, because, although we know the positions of the principal points of the eye according to Gauss's theorem with considerable accuracy, and although we know that the eye suffers from certain aberrations, the data from which we can calculate the distribution of light intensity in the image formed on the retina are very deficient. Neither can we check our calculations by direct observations of the retinal image, because the structures found in the retina are insufficiently fine for the purpose, and we are unable to remove the retina and examine the image by other means without reducing the intra-ocular pressure, and thus allowing the distances between the optical surfaces to alter.

What is wanted is a method of quantitative estimation, applicable to the retinal image, no less accurate than that devised by Hartmann for studying the aberrations of photographic objectives, which has been recently adapted to microscopic objectives also.

Reference may now be made to one other part of the dioptric mechanism, namely the "accommodation." Of this Dr. Troland writes (p. 40) that Helmholtz's theory "borders on the line between legitimate inference and mere hypothesis." In this connexion we may recall that many physiologists hold Tscherning's theory to be the correct one. In fairness to the memory of Helmholtz, it should, however, be stated that several recent workers have obtained results wholly in favour of his view.

Of the retina, and the nature of the processes by which light and colour are perceived, Dr. Troland writes (p. 43): "It is to be regretted that relatively little work upon the microscopic anatomy of the retina has been done in recent times, the epoch-making researches of Raman y Kajal having found no worthy successors." With this opinion every physiologist must regretfully agree; but will there be such unanimity over Dr. Troland's dismissal of Edridge-Green's theory in the following words?—"Views such as those of Edridge-Green, who regards the rods as non-photosensitive manufacturers of visual purple, which latter is operative only in stimulating the cones, may be dismissed at once without serious consideration." Now, however difficult it may be for some of us (who have been, as it were, brought up on the duplex theory of von Kries, which teaches that the rods function in night vision, and that while the hen has no rods and is therefore night blind, the bat has no cones and is therefore day blind) to accept Edridge-Green's hypothesis, we must feel that to dismiss it without consideration is to act too impulsively.

The criticisms which Edridge-Green advances against the older view are very weighty and worth serious thought. It is possible that, as so often in physiology, parts of both views are true and that there may be some half-way hypothesis acceptable to both parties; such, for example, as this: that while cones function principally by day for the appreciation of colour, and rods by night, yet cones do function to some extent at night, by a partial retention of the old functions of the rods from which they were presumably developed, while, on the other hand, rod vision is still to some extent operative in day vision, particularly in regions of the retina, on which are falling parts of the image corresponding to the shadows. It is only by dismissing nothing without consideration, and by research on the lines of Kuhne and of Hecht, that this important problem will be finally solved.

Much the same statement must be made concerning the appreciation of colour. New hypotheses, based on the quantum theory, are springing into being, and there are not sufficient data to enable a decision to be made between them and the older trichromatic theory of Young. Colour mixture equations would suggest that there are pigments present in the retina other than visual purple, but there is great need of direct proof of their existence and quantitative information concerning their distribution in the retina and their spectrophotometric properties. It is not the repetition, which Dr. Troland advocates, of older work that is wanted so much as entirely new lines of attack.

Many other important branches of visual science are dealt with by Dr. Troland in his book, but enough has been written here, perhaps, to show that the volume is a very real contribution to knowledge. No better incentive to future research could have been compiled; let us hope that the harvest will be a rich one.

H. Hartridge.

The Brackish-water Area of the Zuiderzee.

Flora en Fauna der Zuiderzee. Monografie van een Brakwatergebied onder redactie van Dr. H. C. Redeke en met medewerking van Tera van Benthem Jutting, H. Engel, H. C. Funke, Dr. A. C. J. van Goor, J. A. W. Groenewegen, Dr. B. Havinga, J. Hofker, Dr. R. Horst, Prof. Dr. P. N. van Kampen, Geertje de Lint, Dr. J. G. de Man, Prof. H. F. Nierstrasz, Dr. A. C. Oudemans, Prof. Dr. C. Ph. Sluiter, Dr. J. F. Steenhuis, Dr. J. J. Tesch, Dr. Adriana Vorstman, Nel de Vos, Prof. Dr. Max Weber en Dr. N. L. Wibaut-Isebree-Moens. Uitgegeven door de Nederlandsche Dierkundige Vereeniging ter Gelegenheid van Haar Vyftigjarig Bestaan. Pp. 460. (Helder: C. de Boer, Jun., 1922.) 10 guilders; for members of the Nederl. Dierk. Vereen., f. 2.50.

WITH the draining of the Zuiderzee one of the largest brackish-water basins of Europe, and a very peculiar one, will disappear. In the Baltic Sea, the largest of all, tidal movements are of very little importance: in the French and English river-estuaries, tides are the predominating factor, while in the Zuiderzee only a few small areas are struck by regular tidal currents, and the greater part of the southern basin is only shaken up from its lake-dreaminess by north-western gales. Therefore it was a very useful work of the Dutch Zoological Society (Nederlandsche Dierkundige Vereeniging), and specially of Dr. H. C. Redeke, the director of the Zoological Station in Den Helder, to bring together all that is known from the Zuiderzee in this monograph, issued on the occasion of the fiftieth anniversary of the Society.

In recent years a few small expeditions have been made to increase our knowledge of the subject. As the middle part of the southern basin will not be drained, but remain open water, named Lake Flevo, we shall have a splendid opportunity of studying the changing of the brackish-water fauna into a fresh-water community. We do not know how long this will take, but, seeing the amount of water that is brought to the Zuiderzee by the river Yssel, it is almost certain that the days of the brackish Zuiderzee will be counted as soon as the dike between the provinces of Holland and Friesland from Wieringen to Piaam is ready, which will take another ten years. Nevertheless, we must be very glad that the research work has begun in such splendid style.

In the first chapter, the geology and hydrography are treated by Steenhuis and Redeke respectively. The geology is, of course, for the most part based on historical facts, as we know that two thousand years ago there was no Zuiderzee, but a Lake Flevo, as there will be again at the end of this century. The reason for this victory of the sea over the land must lie in the change in relative height of land and sea-level. The author does not give his opinion, however, about the cause of these changes. The hydrography, treated by Redeke, is of extreme importance, as we find here tables of temperature and salinity of the water in different parts of the basin during all seasons of the year. The lowest salinity (4 to 8 *per mille*) is found along the east coast, where the Yssel water flows, and causes a constant stream in a northerly direction.

The flora of the Zuiderzee is treated by Dr. van Goor, and the halophytes and submerged Phanerogams, the Algæ, and the phytoplankton are dealt with successively. Some fifty species of Algæ were collected, among them some that were previously unknown in the Dutch flora. The most important, however, is a new form of Fucus, baptised *F. intermedius*, nov. spec., which is intermediate between *F. vesiculosus* and *F. platycarpus*, and still not to be identified with the *Fucus ceranoides*, the brackish-water form of the French coast, which occurs also in the Schelde River. It should be of great interest to study the Fucus growth in Breydon Water, Hudson Bay, etc., to compare and try to find out more particulars of the distribution and life-history of this interesting group.

A comparison between the flora of the Baltic and Zuiderzee gives the interesting result that, while in the Baltic Cyanophyceæ and Peridiniales form by far the greatest part of the planktonic organisms, in the Zuiderzee the Diatoms play the most important rôle. The Copepod fauna of the Baltic and the Zuiderzee is much the same, but in the phytoplankton there is a difference even in the genera of the most important species.

The Protozoa are treated by Hofker, who gives a well-illustrated review of the specimens collected, which is of great value, as hitherto very little work has been done in Holland on these groups. Especially his account of the Foraminifera will prove a great aid for further investigation. It is highly probable that this shell-bearing group will furnish in later years just as good methods for analysing alluvial and diluvial deposits as diatoms already give. It is a great pity that the publication is merely systematic and morphological, for comparison with other faunas and a partition in salinity groups would have been of the greatest importance. We hope that this part of the work will follow, and point out that van Goor did it for the flora, Funke for the hydroids (twelve species), Geertje de Lint for Cladocera and copepods, etc.

Dr. de Man treats the free-living nematods, and describes among his forty-nine species no less than twelve that are new for science. For particulars I must refer to the publication itself. Twenty species of polychæt annelids were collected, and are treated by Dr. Horst; five species of Oligochætæ, described by Nel de Vos, while Dr. Wibaut-Isebree Moens shows that several Rotifera occur in fresh as well as in brackish water. Then we come to that important group, the Crustacea, important from the fisherman's, and therefore from the scientific point of view, as they have been very thoroughly studied recently. I have already mentioned the Cladocera and Copepoda, studied by Geertje de Lint. A new species of Schizopera is described.

Spongiæ, Cirripeda, Isopoda, Amphipoda, and Schizopoda are all treated, but show no special characters. Among the Decapoda, analysed by Dr. J. J. Tesch, *Leander longirostris*, called the Rhineprawn by British carcinologists, was found only once in the Zuiderzee. The life-history of the specific little Zuiderzee crab, *Heteropanope tridentata*, is very interesting; its only allies live in the tropical Pacific, and it has not been studied before. Illustrations of the larval states will prove very useful in recognising this interesting little creature.

A new Acaris is described by Oudemans; Havinga treats the marine Mollusca, of which several are of importance, as food for fishes and men. *Cardium edule* and *Mya arenaria* have typical brackish-water forms and measures. Among the fresh- and brackish-water Mollusca treated by Tera van Benthem Jutting is the famous *Corambe batava*, Kerbert, found for the first time in 1881; it appears to be not at all rare on the Zostera meadows of the Zuiderzee. Eggs and radula are described and represented. *Assemania grayana* appeared to be a sexual dimorph, the male being much smaller than the female, and being usually found in summer riding on the weaker sex. Among the Bryozoa, treated by the same author, we find the beautiful *Membranipora membranacea* var. *erecta*, which is very common in brackish water in Holland.

Echinoderms and tunicates must be passed here for lack of space. Dr. Redeke's account of the fishes will be of special interest, not only to ichthyologists, but also to others, for here the different zones of salinity are separately described. Last comes Prof. Max Weber, who treats of ten species of cetaceans, of which specimens of all but one, the common Phocæna, have stranded on the banks of the Zuiderzee at different times.

A systematic index, more than eight pages in three columns, increases the utility of this important monograph of a brackish-water area.

W. G. N. VAN DER SLEEN.

Geology for Canadian Students.

Elementary Geology: with special reference to Canada. By Prof. A. P. Coleman and Prof. W. A. Parks. Pp. xx+363. (London and Toronto: J. M. Dent and Sons, Ltd., 1922.) 15*s*. net.

THE issue of treatises on general geology specially adapted to readers and observers in the units of our federal commonwealth is a sign of healthy autonomy in the domain of natural history. Colleges in the Dominions have long been troubled with the details of the English Oligocene, a poor thing at the best, or the Llandovery sequence on the Shropshire border. Aspirants in South Africa have been well served by Mr. A. L. Du Toit's "Physical Geography" and Prof. E. H. L. Schwarz's "South African Geology," since the latter includes a short general introduction to the science.

Profs. A. P. Coleman and W. A. Parks of Toronto now provide Canadian students with a sound elementary text-book based primarily on what may be seen in Canada or in the adjacent United States. The account of the Grenville and Keewatin series, the former consisting of altered shales (garnet-sillimanite gneisses) and crystalline limestones, and the latter of volcanic tuffs and lavas, is very valuable for European students who wish to realise the nature of the oldest known rocks revealed to us in the accessible crust. The eastern series, the Grenville, may prove to be somewhat older than the Keewatin of the west; but both are invaded by the great batholitic intrusions which have given rise, often by interaction with their surroundings, to what may still be styled the Laurentian gneiss. Prof. Coleman's work among the glacial beds of early Huronian age adds greatly to the interest of the pages on Pre-Cambrian rocks.

While European types of fossils are in places very justly figured, such as the Jurassic Trigonias and ammonites of England, we are introduced to the Cambrian trilobites of British Columbia, to Devonian fishes from Canada described by Traquair and Whiteaves, to the Permian reptile Dimetrodon of Texas, with its amazing dorsal spines, and to a Lower Cretaceous Stegosaurus from the province of Alberta. The Cainozoic era, styled also in this book the Tertiary period, is dealt with slightly; yet the thicknesses of its strata in many localities show that its duration was equal to that of Mesozoic times. The spelling "Cenozoic," adopted by the authors, though it follows Lyell's nomenclature of the systems, is etymologically misleading and should be synonymous with azoic. We greet on p. 353 an ancestor of the national maple leaf, culled from interglacial deposits in Toronto.

The book is finely printed and is handsomely illustrated throughout. Too much may have been attempted in one volume, and the definitions of divisions of the animal and vegetable kingdoms on pp. 155-160 are necessarily unsatisfying and incomplete. Some of these divisions are further treated in the chapters on stratigraphy; but where are the radiolaria, which have a significance as rock-formers? Five or six pages more would have made the description of mineral characters almost adequate. As it is, we have a not too accurate summary of the crystallographic systems (the principal axis, for example, in the tetragonal and hexagonal systems is said to be "long"), while we are led to suppose that quartz is hexagonal. Are the micas, again (p. 12), of different crystal systems? "Mont Pelée," an error sanctioned by Angelo Heilprin, appears under the fine photograph on p. 54. These are small details, and to point them out implies that we know that new editions will be required, and that the next one will still further enlighten us by the possession of an index.

GRENVILLE A. J. COLE.

Mental Athleticism.

Principles of Psychology: the Foundation Work of the Alétheian System of Philosophy. By Arthur Lynch. Pp. xxiii+408. (London: G. Bell and Sons, Ltd., 1923.) 21*s*. net.

MR. LYNCH some years ago published a book in two volumes entitled "Psychology: a New System." Whether, like a famous work of a famous predecessor—the Scots philosopher Hume—his book fell still-born from the press, or whether for other more personal reasons, he has decided to recast it. He now presents it in one volume and describes it as the foundation work of the Alétheian system of philosophy. (Why the first e in the word is given the French acute accent we do not know.) The choice of the name seems to imply a slight on other systems, but probably nothing of the kind is intended, and it is only an expression of the author's boisterous confidence in his own powers.

The personal note is predominant throughout and makes it peculiarly difficult to discuss the doctrine, and impossible to controvert any of the positions. Of course, in psychology, the personal experience carries a peculiar weight. What Mr. Lynch explains to us is how he won his way to the possession of the clear mental grasp of the problem he now enjoys; how he overcame the stumbling-blocks he had to encounter in the perversity of authoritative teachers; how these obstructions actually served him to gain his vantage-point; and how we, if we will follow him, may become mental athletes also. Naturally his appeal is to the young. The curious thing to the older reader is that the solution offered as new is certainly not novel. We are to find the fundamental processes of mind in the same way in which the chemist and the physicist find the fundamental processes of matter. Having discovered them we shall find for the science of psychology, as they find for the sciences of chemistry and physics, that construction follows naturally. Very good, we may think, at any rate as a preliminary discipline,—but then Mr. Lynch does not set his followers to look for these fundamental processes, he puts in their hands the list of them. The processes are twelve in number, and the proof that they are fundamental and that the list is exhaustive is that Mr. Lynch has himself verified that they are so.

The reader will find an enormous number of references to other writers and an extensive survey of science in all its branches. Special importance is attached by the author to the section on memory, the whole of which is based on careful observations and experiments in connexion with his own personal experience.

Our Bookshelf.

John Penrose: a Romance of the Land's End. By J. C. Tregarthen. Pp. vi+342. (London: J. Murray, 1923.) 7*s.* 6*d.* net.

IT is not often that a book of fiction comes within the class of literature appropriately noticed in NATURE, but Mr. Tregarthen includes in his delightful romance of "John Penrose" so many interesting sketches of the wild life of the Land's End peninsula that we feel justified in recommending the book to all students of natural history.

Those who know West Cornwall must recall many an old man such as John Penrose was when the local parson inspired him to "put down" his recollections as the not uncommon farm boy who is keenly observant of the habits of the many pests, and a few wild friends, of the farmer working a small patch of land adjacent to an unreclaimed moorland. The wild animals come into the story as naturally as the human characters, and, with references to them, the author records many old local customs and beliefs that are in danger of being forgotten, as well as sayings and expressions of the old folk which are in danger of becoming obsolete through the influence of the modern school teacher, who, too often, gives his pupil the impression that old English provincialisms are vulgarisms inconsistent with modern education.

Not the least interesting among the conclusions to be gathered from the incidents described is the local attitude of highly respectable people to smuggling: to be entrapped by the preventive officers carried its measure of disgrace, but neither the otherwise rigidly honourable yeoman, nor even the parson, thought it wrong to conceal information about smuggling.

It is not easy to avoid anachronisms when writing autobiographically about a past period, and Mr. Tregarthen has not succeeded in avoiding every pitfall. In referring to the miners who had returned from the gold diggings of California the author recalls a familiar feature of West Cornish life in the 'sixties and 'seventies, but the incidents which he describes on pp. 2, 65, and 68 obviously refer to a period before 1848, the year in which the first Californian gold fever actually started.

T. H. H.

The Annual of the British School at Athens. No. 24. Sessions 1919–1920; 1920–1921. Pp. viii+280+14 Plates. With Supplementary Paper No. 1: *The Unpublished Objects from the Palaikastro Excavations,* 1902–1906. Described by R. C. Bosanquet and R. M. Dawkins. Part 1. Pp. xii+160+34 Plates. (London: Macmillan and Co., Ltd., 1923.) 63*s.* net.

THE article of most general interest in this excellent number is that by Mr. C. A. Boëthius on primitive house types as illustrated from Mycenæan and Nordic structures. The results of recent excavation on prehistoric Greek sites show that there is no evidence to support, still less to prove, the widespread assumption that the round hoop-roofed house is the original type from which all forms of human houses have been evolved. There is a considerable variety of primitive forms, and both rectangular and round huts and houses occur contemporaneously in ancient times and at the present day among primitive races. In Greece the neolithic material shows that well-developed round huts and equally advanced rectangular houses were contemporaneous. In Sweden we find round huts, possibly developed from a primitive tent or a screen against wind and rain. In the Bronze Age come oval houses developing into the rectangular form. "The evidence of primitive European dwellings shows, besides round tents or huts and pent roof structures, horseshoe screens with a fire in front of them, and rectangular screens with their various forms of development centring on the fire. Anywhere in Europe, climate and material can thus suggest a beginning which leads to a round hut, a horseshoe-shaped hut, or a rectangular hut with a central or eccentric hearth, and door at one end. A rectangular house with a central hearth can be just as elementary as a round or horseshoe-shaped neolithic hut, and of entirely independent origin."

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.*]

The Micelle—A Question of Notation.

THERE is a class of colloids, recognised as a class for very many years, in which the substance is a salt of an ordinary ionisable type the peculiarity of which consists simply in a prodigious disparity in size and solubility between the two parts of the salt molecule. Such are many proteins, some dyes, and soaps, to enumerate them in the order in which they have been investigated. What all colloids do surreptitiously, namely, take to themselves uncovenanted ions, these do in an honest straightforward chemical fashion.

The properties of the class *qua* colloids were, I believe, first worked out by myself in the years 1898–1905, the special case examined being certain proteins, called globulins, which present the added complexity that they combine not only with acids and alkalies to form salts, but also with neutral salts themselves. In spite of this, when the large number of variables was disentangled, the behaviour of the substances was found to be singularly orderly, the phase-rule diagram, for example, being strikingly like that of a common-place three-component system bearing no suspicion of colloidality.

These colloid salts present one striking peculiarity, namely, that though in water they ionise and hydrolyse on the whole according to the approved pattern, yet one of the molecular species, and that the one which confers upon the solution its most characteristic qualities, is a complex composed for the most part of undissociated salt molecules but with a surface electric charge due to ionisation at the surface.[1] To these bodies I gave the name "colloidal ions." This is strictly accurate notation, for it is because of these complexes that the solutions possess the characteristic colloidal trick of slurring over the obligations of the chemical law of definite and multiple proportions, and they are ions as Faraday used the word, for they wander (*ἰὸν*) in an electric field.

I pointed out that they conformed to Helmholtz's analysis of the condition of electric endosmose, the density of the charge on the surface being constant, and the total charge, therefore, proportional to the surface area. This, of course, obtains only when the solution has had time to forget its past history and to come into equilibrium; waiting for which state needs, in colloidal society, a vast gift of patience.

In the years which followed, much excellent work was done on another example of the group, namely, congo red, by Bayliss, who described aggregates of anions, the total charge being the sum of the charges of the constituents; and still later, a third example, namely, ordinary soap, was investigated by McBain, who rediscovered the colloidal ion but christened it "micelle."

Now accuracy of notation is the breath of the life of science, and to use the word "micelle" for a colloidal ion seems to me to be positively wrong, since the word was introduced by the botanist Nägeli in 1877 to describe something entirely different. Nägeli was a man of a curious imagination but he clothed his dreams in exact language. He is precise as to what he means by "micelle." The word was coined amid a controversy which raged in the 'seventies and 'eighties concerning a distinction then drawn between organised and unorganised colloids and the causes of "swelling."

Nägeli, who was an intellectual heir of the Frankenheim of 1851, began with molecules in 1858, but by 1877 he had identified the unit of the colloidal state as an aggregate of composite type to which he gave the name "micelle." This he supposed to consist of a nucleus of solute surrounded by an atmosphere of bound water. The water atmosphere was the essence of his conception, which had nothing to do with electric charges or with ionisation. A single "micelle," or a micellar chain, contained a micellar nucleus, or nuclei and micellar water. A gel was conceived as being composed of such chains with their micellar water, disposed as membranes or bars to form a sponge enclosing extra-micellar or "enclosed" water.

In complete opposition to Nägeli was Strasburger (1882), a molecularist in the direct line of descent from Kekule. Between stood Pfeffer, whose forebears were Dutrochet, 1827, Nägeli of 1858, Graham, 1864, and Traube, 1867; van Bemmelen had no kinship with Strasburger, he follows on the latest stage of Nägeli (1880) and Pfeffer.

I have just been looking through my thirty-year-old notes of that discussion. What a lot those people knew which is now forthcoming as new knowledge! They knew, or at any rate conjectured, that the colloidal particles were strung together in thread-like masses in some colloidal solutions, and it will do no harm to remind those who propound theories of gel structure that they knew such theories must account for hydrostatic pressures of upwards of 45 atmospheres.

The colloidal ion is far removed from Nägeli's "micelle"; it is nearer to the supposed colloidal unit which Pfeffer called a "tagma," and described as an overgrown aggregate of one species of molecule, namely, those of the solute.

Had recent workers known of these earlier hypotheses they would possibly have been content with the words "colloidal ion" for the constitution of soaps. That brings me to the gist of the matter: in the early 'nineties when, as a physiologist, I was attracted to colloids, I found two schools, both of whom had done excellent work, wholly unacquainted with each other's writing. Ringer, for example, on the biological side had demonstrated on the living heart the differential action of ions and "antagonism." He did not recognise the full significance of his observations because, like all contemporary biologists, he was wholly ignorant of the work of Schulze, and of Picton and Linder. The two schools presently came together to the advantage of both, but now the striking want of acquaintance by many chemists with colloidal work published in the biological journals is symptomatic of a renewed falling apart. How many physicists or chemists know of Mines's brilliant work on membrane potential?

It is impossible to avoid rediscoveries in science because of the enormous burden of knowledge, but it is in every one's interest to minimise them. Out of the mouth of a sinner comes, I hope, good advice. I must be the greatest of sinners myself, for it is certain that no one reads other people's science with greater reluctance than I do.

W. B. HARDY.

[1] A most interesting suggestion as to their structure is that of Adam, in the Proc. Roy. Soc., A, xcix. 336, 1921.

Problems of Hydrone and Water: The Origin of Electricity in Thunderstorms.

THE subject of the electricity of rain and its origin in thunderstorms was dealt with by Dr. G. C. Simpson in a communication to the Royal Society in 1909 (Phil. Trans., 1909, A, vol. 209, pp. 379-413). Taking

Lenard's observations and his own experiments into account, Dr. Simpson concludes that it is not an induced effect, due to an external source; he considers that there is an actual production of electricity in the *subdivision* of large raindrops.

Dr. Simpson's conclusion has long been in my mind. Latterly, the subject has been an attractive one to me, on account of the views I have formed of the composition of water and of the chemical changes attending alteration in the size of drops, referred to in my recent communication to the Royal Society (Roy. Soc. Proc. A, vol. 103, p. 616, 1923). I was much impressed by a lecture at the Royal Institution given early in the year by Dr. Simpson (NATURE, April 14); this, together with a violent hail-thunderstorm which I experienced while yachting in August, led me to look more closely into the problem.

Assuming that water be the cause, the view I should be inclined to take is the converse of that advocated by Dr. Simpson. Granting, for the sake of argument, that changes in water can give rise to free electricity, the fusion of small drops into large would seem to be the more likely process—this being a positive change, in the sense that energy is liberated, while the division of large drops should involve a loss of energy. I assume that the small drops are richer in hydrone than the larger and that changes in composition of the water take place such as I have postulated in my recent communication.

Going further, however, can it be granted that chemical changes *in a wholly liquid circuit* ever give rise to sensible electricity—must not the circuit *be tapped by conducting electrodes* to make this obvious? We must assume that the interactions are primarily electrolytic, but is not the electrical energy, in such cases, always lowered into heat energy?

The question is of fundamental importance, and it is on this account that I make bold to be critical of a solution of a problem outside my field; yet it is one of the borderland issues which chemist and physicist should jointly consider.

Assuming that my interpretation be correct, may not the great rise in potential required to produce lightning have its origin in the coalescence or co-operation of minute drops charged by an external source?

Lenard (*Wied. Ann.*, 1892, 46, p. 584) dealt with the effect, in the first instance, in studying the electricity of waterfalls. His later laboratory experiments led him to the conclusion that it was due to the impact of separate drops upon a flat surface. The water was allowed to splash *into a zinc tray*. Both he and Dr. Simpson found it necessary to use distilled water; that from the mains gave little or no result. The air potential observed was negative, but with a solution of salt it was slightly positive. Up to a certain point, the potential increased rapidly with the length of the jet. Various liquids other than water were tried: the potential varied in sign and magnitude, but the effect was slight as compared with the water effect. Lenard seems to think that the effect has its origin in a contact difference of potential between gas and liquid. All seems to me to point to chemical interchange being at the root of the phenomena and that it is not a mere water effect.

HENRY E. ARMSTRONG.

Earthquake Warnings.

THE recent disaster in Japan demonstrates the importance of endeavouring to ascertain if there are any premonitory indications of a coming earthquake shock which can be recognised and thus enable a warning to be given of its approach.

It seems probable that the rupture, whatever its nature may be, that gives rise to the actual vibratory shock of an earthquake is preceded by a strain or distortion of the earth's crust, which gradually increases till the stress that causes it is suddenly released. The existence of this strain should be evidenced by a progressive sag or tilt of the surface, local and minute in amount, no doubt, but probably sufficiently large to be detected.

In the Milne-Shaw seismometer the vibrations proceeding from distant earthquakes are recorded on sensitised paper on a rotating cylinder by a spot of light reflected from a mirror coupled to the boom of a horizontal pendulum. Ordinarily it is only these vibrations that are taken into consideration, but the same instrument will also indicate a slow tilt of the ground, provided that the exact position of the spot of light can be recorded and measured. In some instruments recently constructed, one of which is being installed in Uganda, this is effected by the use of a second, stationary mirror, which throws another spot of light in a fixed position on the cylinder, and traces a straight line on the record. If there is a tilt of the earth's surface it will be indicated by a variation in the distance between the mean position of the line due to the moving mirror from that of the line due to the fixed mirror, unless of course the tilt is in a direction parallel to the horizontal pendulum. Such an instrument is capable of showing a tilt of $\frac{1}{75}''$ by a movement of the indicating spot of light through 1 mm. If two instruments are employed with their horizontal pendulums at right angles to each other the direction and amount of the tilt will be exactly determined. Near the sea the rise and fall of the tide causes a slow tilt and other changes of a slow periodic character are known, but these can be allowed for and could easily be distinguished from a progressive movement indicating the approaching occurrence of an earthquake in the neighbourhood.

It seems very desirable that such instruments should be installed in localities which are known to be subject to earthquakes.

If it be found that shocks are in fact heralded by a definite tilt, it may be possible to arrange for an electric bell to attract the attention of the observer when such a tilt occurs. If he is satisfied that there is sufficient evidence of an approaching earthquake, a general alarm can be sounded. In this way a warning might be given several hours, or even days, before the shock occurred.

JOHN W. EVANS.

Imperial College of Science and Technology,
S. Kensington, S.W.7.

Human Embryology and Evolution.

IN his reply to Prof. MacBride (NATURE, Sept. 8) Sir Arthur Keith states that in his Huxley lecture he neither affirms nor denies the doctrine of use-inheritance, but that he does deny that Lamarckism has had no part in the evolution of man. If these words were to be taken literally as expressing Sir Arthur Keith's meaning, he and I would be to a great extent in agreement, but it is obvious that the double negative was an accidental mistake, and that Sir Arthur Keith meant to deny that Lamarckism had *any* part in the evolution of man.

I have read the report of his Huxley lecture to the medical students of Charing Cross Hospital Medical School (NATURE, Aug. 18), and it seems to me difficult for an evolutionist to follow his train of thought or reasoning. He does not distinguish between the development of the individual and the evolution of the race, between ontogeny and phylogeny. He discusses the manner in which adaptations appear during the development of the human embryo, taking as examples the development of the eye, of young nerve-cells, of muscular adaptations. In the adult human leg the peroneus tertius is separate in 90 per cent. of cases, having thus an advantageous position for the performance of its function in walking. In the anthropoid apes this muscle is quite unseparated from the long extensors of the toes. In the developing human fœtus the rudiment of the peroneus tertius separates from the long extensors with which it was originally continuous. To most biologists this would be a typical case of recapitulation.

Sir Arthur Keith says he agrees with Huxley that there are no grounds for believing that the behaviour of embryonic muscle cells is in any way influenced by experiences gained by adult muscle fibres. He then makes the statement that "The evolutionary machinery lies in the behaviour of the embryonic muscle cells or myoblasts," which to me, as it stands, is quite unintelligible. The behaviour of the embryonic muscle cells can explain nothing but the mode in which the adult structure is developed. Such behaviour begins and ends with the individual organism, and cannot possibly contain any evolutionary machinery. It is merely one detail of the complicated embryological changes by which the adult structure is developed. In relation to evolution the question is how are we to explain the fact that the "behaviour of the embryonic cells" is different in the human fœtus from what it is in the anthropoid apes, which presumably resemble the ancestral condition? On this question Sir Arthur Keith says nothing, except the assertion quoted of his agreement with Huxley.

In another part of his lecture Sir Arthur Keith discusses the action of hormones in the course of ontogeny in co-ordinating the development of different parts and tissues. He concludes that more complete knowledge "will reveal in full the true nature of the machinery which underlies the production of structural adaptations which occur in every part of the animal body in every stage of its evolution." Here, again, he is confounding the evolution or origin of the adaptations with their mere development in the individual.

Nevertheless, Sir Arthur, while denying the influence of external influences in human evolution, admits the heredity of "acquired characters" and even injuries in certain cases. He states that Lamarckism cannot explain the characters which differentiate one racial type of modern man from another. On this last point I am entirely in agreement with him, for Lamarckism is a theory of the evolution of adaptive characters, and racial characters of man are for the most part not adaptive.

I should like in conclusion to contrast two passages in Sir Arthur Keith's lecture. He writes, "Nothing is better known than that, if a bone of a rickety child bends under the weight of the body, the bone cells lying in its concavity will proliferate and build a buttress to strengthen the shaft." The bone cells "react to fulfil an end necessary for the occasion." This seems to me quite inconsistent with the statement, "there are no grounds for believing that the behaviour of embryonic cells is in any way influenced by experiences gained by adult muscle fibres." The first of these two passages admits the *reaction* of the tissues of the body to external stimuli, while the second passage and the whole tendency of the lecture apparently denies the occurrence of such reaction.

J. T. CUNNINGHAM.

Chiswick, W.4,
September 11.

Curious Spherical Masses in Ashdown Sands.

MR. HARRY E. BURNS, of Crowborough, this spring informed me of some remarkable spherical masses of sandstone in the Ashdown Sands at High Hurst Wood Quarry, and was good enough later to supply one about 10 inches in diameter to our Museum. He suggested that they might be sand casts of reptilian eggs like that of the Iguanodon. They consist of fine-grained nearly white stone—much of the iron having been leached out. I expected but failed entirely to find on section any pan or stains of limonite such as in the well-known balls of Folkestone Sands.

Recently I have visited the quarry with Mr. Burns, and was able to see a ball 30 inches in diameter in position. We were told they are confined to an upper bed about 14 feet thick, and vary in size from 10 to 30 inches in diameter. We could discover no evidence

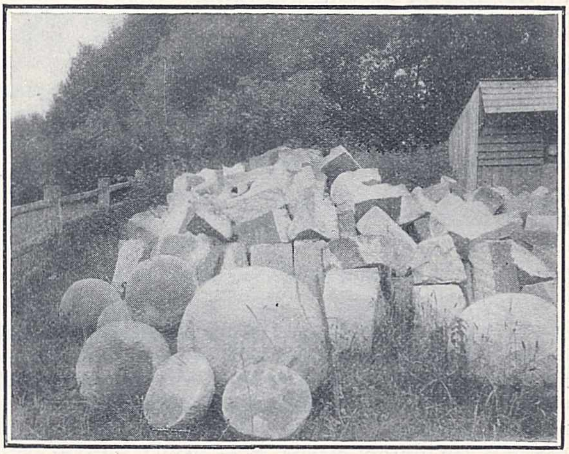


FIG. 1.

of a foreign body or of concretionary growth, although such growths are not rare in the Wealden Sandstones —often, too, in a decalcified condition. Those at Crowborough are found loose in a narrow cavity, and the stone appears identical in colour, etc., with that of the surrounding bed. The adjacent stone for a few inches is shattered—due, I suppose, to the pressure of overlying beds against the unyielding sphere, while the narrow clefts are filled with clay, doubtless washed there from the once overlying Wadhurst Clay. Strangely enough, some of these balls have been used as ornaments at the tops of wooden gate-posts! During the forty-five years I have lived in the neighbourhood I have not met such masses before, and find them difficult to explain. The photograph (Fig. 1) shows a group of these stones taken by Mr. Burns, who kindly allows me to use it. GEO. ABBOTT.

2 Rusthall Park, Tunbridge Wells,
September 10.

Stereoisomerism among Derivatives of Diphenyl.

DR. TURNER's remarks (NATURE, September 22, p. 439) appear to have been made without his having seen my letter of some eighteen months ago (NATURE, May 6, 1922, p. 581), which was concerned with the importance of stereoisomerism among diphenyl derivatives in relation to Sir William Bragg's conclusions as to the molecular structure of benzene in the crystal. At that time, reasons for reviving the Dewar para-linkage formula for benzene had not been published (Ingold, Trans. Chem. Soc., 1922, 1143), but since this bridged formula "is stereochemically identical with the disposition of atoms suggested by Sir William Bragg for the molecule of benzene" (Challenor and Ingold, Trans. Chem. Soc., 1923, 2068), it will scarcely be maintained that Dr. Turner's suggestion of a possible stable para-linkage in diphenyl derivatives introduces any essentially novel consideration to the question of the structure of these compounds. I also referred in my letter to the remarkable behaviour of diphenyl towards ozone, mentioned by Dr. Turner, as well as to certain other noteworthy properties of the compound.

It should perhaps be pointed out that although, as Dr. Turner states, the formula considered by him contains four asymmetric carbon atoms, it would be incorrect to suppose that it therefore demands the existence of a correspondingly large number of stereoisomeric forms of 2 : 2′-derivatives of diphenyl. For the respective distributions of the groups attached to the pair of asymmetric carbon atoms in either benzene nucleus are not mutually independent, so that only one asymmetric atom in each nucleus is effective as a source of stereoisomerism.

In conclusion, I need scarcely say that experiments on the isomerism in question are being actively prosecuted in this laboratory, and are by no means limited to 2 : 2′-derivatives of diphenyl.

J. KENNER.

The Chemical Department, The University,
Sheffield, September 25.

Waves and Quanta.

THE quantum relation, energy $=h \times$ frequency, leads one to associate a periodical phenomenon with any isolated portion of matter or energy. An observer bound to the portion of matter will associate with it a frequency determined by its internal energy, namely, by its "mass at rest." An observer for whom a portion of matter is in steady motion with velocity βc, will see this frequency lower in consequence of the Lorentz-Einstein time transformation. I have been able to show (*Comptes rendus*, September 10 and 24, of the Paris Academy of Sciences) that the fixed observer will constantly see the internal periodical phenomenon in phase with a wave the frequency of which $\nu=\frac{m_0c^2}{h\sqrt{1-\beta^2}}$ is determined by the quantum relation using the whole energy of the moving body—provided it is assumed that the wave spreads with the velocity c/β. This wave, the velocity of which is greater than c, cannot carry energy.

A radiation of frequency ν has to be considered as divided into atoms of light of very small internal mass ($<10^{-50}$ gm.) which move with a velocity very nearly equal to c given by $\frac{m_0c^2}{\sqrt{1-\beta^2}}=h\nu$. The atom of light slides slowly upon the non-material wave the frequency of which is ν and velocity c/β, very little higher than c.

The "phase wave" has a very great importance in determining the motion of any moving body, and I have been able to show that the stability conditions of the trajectories in Bohr's atom express that the wave is tuned with the length of the closed path.

The path of a luminous atom is no longer straight when this atom crosses a narrow opening; that is, diffraction. It is then *necessary* to give up the inertia principle, and we must suppose that any moving body follows always the ray of its "phase wave"; its path will then bend by passing through a sufficiently small aperture. Dynamics must undergo the same evolution that optics has undergone when undulations took the place of purely geometrical optics. Hypotheses based upon those of the wave theory allowed us to explain interferences and diffraction fringes. By means of these new ideas, it will probably be possible to reconcile also diffusion and dispersion with the discontinuity of light, and to solve almost all the problems brought up by quanta.

LOUIS DE BROGLIE.

Paris, September 12.

The "Concilium Bibliographicum."

IN the commentary added to my letter concerning the "Concilium Bibliographicum" which appeared in NATURE of June 30, p. 880, some doubts were expressed regarding the continuous appearance of its cards. May I be permitted to emphasise again that our cards are issued and delivered as heretofore to our subscribers.

Another publication of the Concilium is the "Bibliographia Zoologica," of which volumes 30 and 31 have been published and vol. 32 will be sent out shortly, indicating definitely that this zoological bibliography is not a new undertaking of the Concilium.

No doubt it is a rather complicated question to decide whether or not this zoological bibliography in book form is a duplication of the "Zoological Record." It must be recalled that apart from completeness, promptness, and accessibility, carefulness and the procedure in the arrangement of the bibliographical work play a very important rôle. Indeed, as for every application of scientific procedure, it is not only the tools but also the degree of ability to use them which governs the appreciation of those who have to work with them. One works better with one method, another is more adapted to the use of another. To all these points have to be added as important factors the influence of different education and local tradition.

In making a plea for a co-operation between the "Zoological Record" and the bibliographical service of the Concilium, a condition which unquestionably could be of real value to the zoological world, the writer wishes to suggest that these various important points of internal character be seriously considered.

When it was decided in 1921 to continue the book-form of the "Bibliographia Zoologica," the material to be published was so extensive that it was impossible to treat the whole animal kingdom in every volume. But this is certainly not a misfortune, for it is evident that a bibliography of titles has not only an immediate value, but also represents to a great extent a source for continuous reference.

J. STROHL,
Director of the "Concilium
Bibliographicum."

Zurich.

Long-range Particles from Radium-active Deposit.

IN the letter which appeared in NATURE of September 15, p. 394, under this heading, by Dr. Kirsch and myself, there are two errors which obscure the sense of our communication. The maximum range of the H-particles expelled from silicon should read 12 cm., the corresponding number for beryllium being 18 cm., instead of vice versa. The last sentence should read: "Our results seem to indicate that an *expellable* H-nucleus is a more common constituent of the lighter atoms than one has hitherto been inclined to believe," the word in italics being omitted in the printing.

HANS PETTERSSON.

Göteborgs Högskola, Sweden.

[The transposition of the values 12 cm. and 18 cm. was the fault of our printers; and we much regret it. The omission of the word "expellable" was due to the authors, who did not include the word in their letter. Two separate proofs of the letter were sent to Dr. Kirsch at Vienna, but neither was returned.—EDITOR, NATURE.]

The Management of Medical Research.[1]

By Sir RONALD ROSS, K.C.B., K.C.M.G., F.R.S.

TWENTY years have now elapsed since I had the honour and pleasure of addressing Anderson's College Medical School at the opening of its winter session of 1903. This is, indeed, only a short interval in cosmic time; for—to use a figure which will exhibit the rapidity of scientific advance nowadays—all these years amount only to twenty vibrations of the electron which we call the earth round its nucleus the sun, in this atom which we name the solar system! However, for us it has been a considerable period. Many of those who faced me twenty years ago as students are now placed in the seats of the mighty, and will, I hope, support what I have to say to-day. Alas! two of the faces with which I was then familiar are missing—Prof. R. S. Thomson, dean of the Medical Faculty, and Sir James Marwick; some of the distinguished men who were helping us—Dr. Laveran, Dr. Robert Koch, Sir Patrick Manson, Sir William Osler, Lord Lister, Sir Alfred Jones, Sir Rubert Boyce—are no more; and, above all, I must mourn that great pupil of the School, a ruler of many Colonies, and my own master, friend, and supporter, Sir William MacGregor.

On that occasion my address was entitled "Medical Science and the Empire," and in it I described the efforts which we were making to reduce malaria in British possessions. Four years previously we had verified, corrected, and completed the old conjectures that malaria is carried in some way by mosquitoes; and three years previously the Americans had proved the similar conjectures regarding yellow fever. Schools of Tropical Medicine had been established in Liverpool and London, and were about to be created in many parts of the world. At that time I myself hoped that malaria would be banished in a few years from all our principal cities in the tropics; and I had visited West Africa from Liverpool on three occasions for that purpose. I shall never forget the assistance rendered during my second and third visits by two Glasgow men, the late Mr. James Coats, who gave us two thousand pounds to start our anti-malaria work in Sierra Leone, and Dr. M. Logan Taylor, who remained in West Africa for two years, carrying out the practical measures and trying to persuade the local authorities to continue them.

My address—which I believe was not published, but which I still possess—was full of that morning enthusiasm. I argued that the time had already come when medical science could revolutionise the tropics; when it could render them worth living in by banishing the great endemic diseases which overshadowed them; when it could assist civilisation (coming from the temperate regions of the earth) to conquer the rich regions of the Sun and of the Palm. I even dared to quote the great words of the poet regarding Columbus, that he

"Gave to man the godlike gift of half a world;"

and I hoped that we should be able to do the same. This had been the faith which had compelled us—others besides myself—for many years: not to add to abstract science, not merely for the sake of parasitology or entomology, not to compile text-books or to fill libraries; but to help the sick and the dying—millions of them—and so to open up the world. When I last spoke to you I hoped that all this was going to be done in a year or two! I am wiser now. Kipling says that we must not try to hustle the East; so, I have found, we must not try to hustle the West either! Men think slowly. It requires a new generation to understand a new idea, even the simplest one.

Some notable advances have, however, been made. Mosquito-reduction against malaria was first urged and defined by us in Sierra Leone in 1899; and was commenced there by Logan Taylor and myself two years later in 1901, and, almost simultaneously, by the Americans under W. C. Gorgas in Havana, and by Malcolm Watson in the Federated Malay States. In 1902 Sir William MacGregor and I visited Ismailia on the Suez Canal—with the result that malaria was banished from that town within a few months. Then the Americans commenced the construction of the Panama Canal, with Gorgas as chief of their sanitary staff, and kindly asked me to visit Panama in order to see them at work in 1904. The result is well-known—the Canal is now finished, with a minimum loss of life. But you are probably not so familiar with the equally great work of Malcolm Watson in the Federated Malay States—because it is merely a British achievement! For more than twenty years he and his friends have fought on against King Malaria and all his allies—rain, heat, jungle, marsh, and ignorance—and is gradually winning forward, step by step. While Gorgas had behind him the full official support of the wealthy American nation, Watson and other British workers in this line have been mostly obliged to rely only upon private initiative and such small funds as they could rake together for their purpose. Not less important has been the work of the entomologists, from F. V. Theobald onwards; but I am not now narrating the history of this movement, or I could speak of many other brave efforts made during these last twenty years. Not perhaps quite as much as I had hoped for, but still something. What may be called "economic sanitation" among our troops, our officials, and our large and numerous plantations, has been greatly improved, and thousands of lives and thousands upon thousands of cases of sickness have been saved. Perhaps, even already, we may echo the words of the Duke of Wellington: "Yes, 'twas a famous victory."

During the same period science has won or is winning many other victories as great. As regards tropical medicine, we have been advancing against plague, cholera, typhoid, sleeping-sickness, kala-azar, hook-worm, beri-beri, bilharzia, and leprosy; and as regards the diseases of temperate climates, we have diminished child-mortality, diphtheria, tuberculosis, numerous ailments due to local infections or to physiological insufficiencies, such as myxœdema, and, quite recently, have inflicted a defeat upon diabetes. We

[1] An address delivered to the Anderson College of Medicine, Glasgow, on October 9, at the opening of the winter session.

are getting on. How? By patient, obstinate, and ineluctable investigation—not in the fields of medicine only, but also in those of physics, chemistry, and zoology. Finally, it is just here that we have scored our greatest victory—against our own stupidity. We, or let us say the public outside these walls, are at last beginning to learn that investigation really matters: we are discovering discovery!

It was not always so, even among doctors. I remember a medical administrator saying, "I cannot keep a number of men idling about here with microscopes," and a High Commissioner exclaiming, "You say you do not know how to manage this outbreak! Surely you medical men *ought* to know." He seemed to think that all we had to do was to consult the Hippocratic Books. The idea that investigation is an essential part of practice has been of very slow growth. In India, when a European doctor was asked to cure a lady of the zenana, he was at one time not allowed to see her, and she was not permitted to do more than put out her tongue at him from behind a curtain. A distinguished English physician, who was, I believe, connected with my own family, is said to have deprecated all clinical examinations: we should know how to cure by instinct. To the public mind the physician loses caste by "wanting to know." He must practice, he may teach, but he should not require to investigate anything!

It has taken us centuries to free ourselves from the serpentine coils of this prejudice and to reach our present position—where investigation is the key-industry of all industries. The evolution of this revolution is interesting. The ancient Greeks certainly valued, not only practice and teaching, but also discoveries when made; yet we are not aware that they ever explicitly organised or encouraged research. Readers of the history of science often wonder how the old philosophers and geometers managed to live at all—probably by teaching and possibly on patronage or charity. They were private enthusiasts, and their fundamental discoveries do not appear to have been rewarded in any way. I am told that it is not known whether Plato demanded fees, as well as a knowledge of mathematics, for admission into his Academy; and the same may be said, I understand, regarding Aristotle's Lyceum. Several of the mathematicians, such as Eudoxus of Cnidos, appear also to have been practising physicians. It is to be presumed that the Museum at Alexandria was in essential particulars like a modern university, where teaching is the official duty of the staff, but where research and practice may be conducted at option between the lectures and classes, often with the assistance of students. We are told that after the collapse of the ancient empires and about the time of William the Conqueror, when Europe was plunged in darkness, the Arabs in Spain possessed a library of 600,000 volumes, an academy, and a fund for the endowment of learned men, probably employed for teaching.

Europe did not advance so far as this for centuries, but the monasteries maintained many learned monks, such as Roger Bacon, with whom the new dawn of science commenced. The great Italian anatomists of the sixteenth century were either practising physicians or members of universities. I think that the first real "research institute," subsidised by public and private funds for pure investigation only, was the famous Uraniborg of Tycho Brahe, founded in Denmark in 1576. It well subserved the proper purpose of such institutes, which is the collection of numerous and exact observations and measurements that are beyond the power of private investigators. Tycho Brahe brought no new integration into astronomy, and even opposed the fundamental theory of Copernicus; but his data enabled Kepler and Newton to revolutionise the science. It is interesting to note that Copernicus himself was only a "private enthusiast," a man of affairs, and a physician; and also that after twenty-one years the politicians stopped their subsidy for Uraniborg, as Mr. Alfred Noyes has described so pathetically in his fine epic of science, "The Torch Bearers." In those days the greatest men were often obliged to pick up a living as best they could—even by the use of alchemy and astrology. Kepler said sarcastically that "Mother Astronomy would surely starve but for the earnings of her daughter Astrology." Even in the observatories and museums which began to be founded after Uraniborg, official duties must have greatly interrupted investigation.

Thus we see that at all times, as often to-day, science has been compelled to get her living by more lucrative but less important pursuits, especially teaching and professional practice. Last century, however, the idea of special research institutes was taken up again with vigour, and the Pasteur Institute in Paris, the Jenner Institute in London, and a score or more similar foundations were established in most of the world's great cities, sometimes by private benefactions or bequests, sometimes by State subsidies, and often by both. Here we find a new principle at work—that of maintaining skilled investigators for research only, apart from teaching and practice. Allied to these, we now possess numbers of industrial research laboratories employed by commercial companies on the improvement of agriculture or of manufactures—and we know what America and Germany have done in this line. Then, again, our hospitals now possess laboratories both for clinical pathology and for research; while the professorial laboratories in all departments of science at our universities have been greatly enlarged and improved, though teaching is still, and quite properly, a part of their duties. Yet another advance is that of research scholarships, by which numbers of promising students are now employed for a few years on such investigations as attract them.

Lastly—and at very long last—the State itself has now joined in the pursuit of truth by means of large annual subsidies, such as those which are distributed in Great Britain by the Department of Scientific and Industrial Research and the Medical Research Council. It would be a difficult task to form even a rough estimate of the world's present expenditure on subsidised research. I think it must reach quite a million pounds a year. This is a small sum compared with the world's expenditure on armaments or education; but it is an improvement on the time when Socrates was obliged to argue in the market-place or Diogenes to fulminate psychoanalysis from a tub.

The improvement has been greatest in connexion with medical investigation. It was not so many years ago that an American who had studied the matter told me that the world then possessed many fewer endowed professorships on pathology and hygiene than on Sanskrit, philosophy, and theology. This was rather surprising. Every one in the world is certain to suffer from some malady at least once; but no one need suffer from Sanskrit or philosophy unless he pleases, nor even from theology—during this life. But there has always been a thin vein of unreality in academic affairs. Now, however, even Sanskrit is beginning to pale before cancer. On the other hand, so recently as last June, I saw the announcement that the chief countries of the world contribute annually an average income of 9,594,254*l.* to the various Protestant Foreign Missions. This is nearly ten times the amount which I conjecture the world is now giving for the whole of its scientific investigations in all fields. North America gives to the Missions an average of 6,327,597*l.* a year and Great Britain gives 2,310,000*l.* a year; Germany has dropped out owing to the fall of the mark, but other countries contribute the balance. We are not jealous, but our mouths water at the thought of these vast sums. On one side, the missionaries, from your great *alumnus* David Livingstone onwards, have been the pioneers of civilisation and have done great work. On the other side, we think of the millions of people now dying prematurely every year of diseases which are probably easily curable or preventable, though we do not know how to cure or to prevent them at present.

On the whole, I think that the war-funds of science are likely to go on increasing year by year as the public becomes more and more convinced of results. The fundamental question is therefore now being asked, How best should we spend the money? Remember that, as I have shown, the endowment of investigation apart from teaching is only a recent innovation, and probably, like all new methods, has not yet been perfected. How can the best results be obtained for the least expenditure? The question must ultimately be decided by you young people: for us it remains only to attempt a preparatory analysis.

Regarding *medical* research there are two schools of opinion, which we may call the *Bulls* and the *Bears*. One school, the Bulls, say: "We must spend every penny we can raise on constant investigations managed by capable committees and carried on by trained research workers, maintained if possible for life in order to be sheltered from the necessity of teaching or practice, and provided with the most up-to-date laboratories, plenty of materials, and easy access to scientific literature. It is true that some money may thus be wasted, that some of the results may prove wrong, that some of the workers may not turn out so capable as they were thought to be: no matter. A single great success will be worth all the money that is likely to be spent in this way. Pour out the cash; catch all the young men you can and set them at their measurements and microscopes, and keep them at it as long as they are willing to stay. The larger the number of seekers the larger the number of finders. Drop the failures, cut the losses, and think only of the profits." To them the other party, the Bears, reply: "You can spend what money you like but you cannot buy discovery. All that your managing committees and trained investigators are likely to do or achieve will be the study of details along already well-trodden paths. They will inoculate legions of rats and guinea-pigs, and will publish profound but incomplete papers every quarter, which will be of little or no use in practice. They will carry out researches—yes, academic researches, and too many of them! But the world does not ask for researches; it asks for discoveries—not for the incomplete but for the complete article. Has a single great medical discovery been made by managing committees and subsidised investigators? Discoveries are made by genius—and that you cannot buy."

Such are the opinions which one hears on both sides. Personally I agree and yet disagree with both. There is only one way to decide. Research and discovery are themselves natural phenomena, and we should study them scientifically. I said we have discovered discovery: let us also investigate investigation. How? By consulting the great and triumphant history of science, particularly the stories of the chief advances. If we do so we shall see that the two parties are merely quarrelling over the two faces of the same coin. Science proceeds, not in one, but in two ways: first by collecting facts and then by basing inductions upon them. Thus, in the classical example already cited, it was Tycho Brahe who spent his life in collecting trustworthy observations regarding the positions of the heavenly bodies, but it was his pupil Kepler who, after twenty-five years' study of Brahe's figures, established the great induction that all the planets move in similar elliptical orbits round the sun; and it was Isaac Newton who, eighty years later, explained all these orbits by the single law of universal gravitation. That is, one man collected the facts, but other men explained them. For a second example: by the middle of last century numbers of workers, including Buffon and Linnæus and a host of private enthusiasts and amateurs, had observed, distinguished, and described innumerable kinds of plants and animals; then came Darwin, who explained these facts—much more numerous than he could ever have collected single-handed—by his theory of natural selection. For a third example: think of the host of physicians, surgeons, and apothecaries who have studied and described the characters and symptoms of human maladies without being able to explain them. Then came Semmelweis, Pasteur, Lister, and Koch, who created bacteriology.

Certainly observation and induction have often worked together in the same research, with brilliant results. More often they pull different ways and break down. Every one knows the man who begins with his induction and then fits his facts to it—or thinks he does. On the other hand, the "working hypothesis" frequently suggests invaluable, though possibly negative, experiments. Then we have the men—generally young men—who make a new generalisation with every new observation: I was one of them once. Often, however, observation and induction require very different faculties, which belong to different men, often living in different ages. If we were all Newtons there would be no problems left to solve.

Science needs all the faculties—the eye of one man, the hand of another, and the brain of a third. Observation is at least as necessary to it as induction. Therefore I do not agree with the party of the Bears when they depreciate subsidised investigations carried out by full-time workers under managing committees. The present state of medical science requires constant physiological, pathological, therapeutic, and biochemical researches, often involving delicate measurements which cannot be made by medical practitioners outside laboratories, or even by teachers in the medical schools in their spare time. Spend therefore as much money as you can raise for this purpose; let every budding Pasteur have his chance; and pray for a Rockefeller. But at the same time considerable waste must be expected and allowed for. One does not envy committees of management. As Sir Ernest Rutherford recently said in his address to the British Association: "Those who have the responsibility of administering the grants in aid of research for both pure and applied science will need all their wisdom and experience to make a wise allocation of funds to secure the maximum of results for the minimum of expenditure. It is fatally easy to spend much money in a direct frontal attack on some technical problem of importance when the solution may depend on some addition to knowledge which can be gained in some other field of scientific inquiry, possibly at a trifling cost."

I can adduce many other difficulties. Workers are apt to be called away to other posts before their task is complete. Then who can know when an old vein is exhausted, or whether a proposed new line is really promising, unless he himself has worked at the job?—and few committees can consist of specialists in all possible lines. In my own subject I have known men employed who had never read the literature, who dug up again old disused workings, or who chased the wild goose with a pinch of salt for years—all costing money. But the greatest waste is caused by the large number of incomplete articles, constantly being published, which, though they may be good so far as they go, are lost in the mass of literature—so that when the man who clears up the question finally arrives he is obliged to rediscover all the matter for himself. But in spite of these difficulties I agree with the Bulls. The world must continue spending money in this way; and it will improve the system with practice.

Now for the other side—the obverse of the medal. One of our most distinguished physicians told me a few months ago that some one had accused him of not really being a man of science because he did not work in a laboratory! Yet he has made more valuable additions to medical knowledge and practice than has fallen to the lot of most laboratories. Consider this point carefully. The work of the laboratory has almost always been the collection of facts and measurements, the elaboration of detail, the testing of theories; but the other side of science, the great inductions which have solved problems or have applied facts directly to the cure or prevention of disease have been made mostly by that humble individual, the "private enthusiast"—generally either a teacher or a "mere doctor." William Harvey was a mere doctor; Edward Jenner, a mere country doctor! What laboratory did Jenner require? He did not even use a microscope, and yet he gave to humanity the greatest single boon which it has ever received, and also initiated our present knowledge of immunity. G. F. E. Küchenmeister, who first proved alternations of generations in parasites, was a practising doctor. Pasteur was a professor of chemistry. Lister was a practising surgeon in Glasgow. Robert Koch was also a mere practising country doctor when he discovered the bacilli of anthrax and of surgical sepsis, the staining of bacteria, and plate-cultivation, thus making practical bacteriology. Manson was a doctor in China. Laveran, Bruce, Reed, and Leishman were or are army doctors. Need I mention any more names?—I should have to hurl almost the whole history of medicine at you! Where were the laboratories of these men?—in their own hospitals and consulting-rooms. Where were the laboratories of Kepler and Newton?—in their own brains. Who are making the innumerable advances which we see to-day in connexion with medical, surgical, and sanitary practice regarding almost all diseases? Very largely our professors, our teachers, our laboratory workers, it is true; but also, and not less, our clinicians and our hygienists.

We see then that there is much to be said for the Bears as well as for the Bulls. It is an historical fact that most of the greatest advances have been made by men who were not subsidised for their researches. I think, therefore, that the whole field of public support for science should be broadened so as to include such men. At present the public gives considerable sums for institutional investigations with the test-tube, the scalpel, and the microscope, but little or nothing for workers outside. That is, it supports, and rightly supports, observational science, which is largely ancillary, but scarcely helps those great intellectual investigations which mostly obtain the final or useful results. It would have subsidised Tycho Brahe's observatory at Uraniborg; but it would probably have refused a penny to Kepler, or to Newton, or to Jenner. It pays for digging the foundations of the Temple of Medical Science, but leaves the building of the walls and towers to the practitioner and the enthusiast—often at their own cost. It pours out money for the expectation of discoveries to come, but refuses to give anything for discoveries already completed by private individuals!

It seems to me that all this is very "bad business." We should pay not only for expectations but also for results. I should like to see the whole medical profession brought into the research fold—not in laboratories, but in their practice, their consulting-rooms, and their own brains. Some one will say that the private enthusiast will continue to work whether we help him or not—surely the meanest argument ever used!—but will he? Then some one else will exclaim that there is nothing to hinder any and every medical man from investigation. I am not so sure. True, hundreds or thousands of them are now actually thus engaged, and, in fact, are obtaining the important results just mentioned; but large numbers of medical men cannot always afford such a luxury, because they have to maintain their practices. The reason for this is that while clinical researches which improve medical and surgical treatment often *enhance* practice—and very deservedly so—other scientific work, such as physiological and pathological studies, which are off the main lines of clinical research, often notoriously *injure* practice. There is still a feeling that a man will not be "a good doctor" if he takes to flying the scientific kite too often. Thus every one knows that both Harvey and Jenner ruined their respective practices by their scientific studies. For another example, it was said of Thomas Young, the father of physiological optics and discoverer of many great theorems on light, heat, and energy, that he "was not regarded as a successful practitioner, because he studied symptoms too closely, although his treatment was admitted to be effective." In other words, he cured his cases by studying their symptoms instead of studying the correct bed-side manner! Wise or not, this feeling has to be considered by practical men. Then there is a third class of effort—perhaps the very highest class of medical work—which is concerned with the prevention of the great epidemic diseases. At present it receives no payment whatever, either from practice or otherwise. What has been done, for example, for Mr. W. M. M. Haffkine or for Mr. H. E. Hankin—both laymen and private enthusiasts—whose studies have saved untold numbers of lives from cholera and plague in India and elsewhere; or for the almost unknown doctors who discovered that plague—the world-destroying plague—is carried by the rat-flea?

Such drawbacks, and others, are unfortunate, because they tend to impede enlistments in the great voluntary army of medical science. Our friend the private enthusiast is a rare species; and the successful enthusiast is very rare indeed. You cannot subsidise him beforehand, because you cannot discover him until he has *done his work*. You can supply him with laboratories, test-tubes, and microscopes—if he wants them, but you cannot pay him for his thoughts, his calculations, or his natural aptitude, nor, above all, for that passion for discovery—for discovery not merely for investigation—which drives him over every obstacle to his ultimate goal. You cannot subsidise him, and you cannot reward him either. It is beyond the power of the whole earth to reward him; his discovery is his reward. But still you can do something for him in a small way. In 1802 and 1807 Parliament compensated Jenner for the loss of his practice; in 1884 the German government did the same for Robert Koch; and quite recently, I understand, the Canadian government has, very wisely, shown the same consideration to Dr. Banting for his brilliant labours on insulin.

The *least* that the world can do for the successful investigator, whomsoever he may be, is to pay honourably such of his little out-of-pocket expenses and losses as he may have incurred in the world's service; and the *most* that the world can do for him is—to keep him at work. This is the way in which money can now be most profitably spent for science. I see that Sir Alfred Yarrow has recently given a fine donation, which is to be devoted partly to this purpose. If I were a millionaire I should follow his example.

It is often said that there is no such thing as discovery, that each advance is built upon previous advances. True; but what is the interval between these advances? Many people carry on incomplete investigations, and just miss their triumphant culmination. The culmination is the discovery. I have often wondered how it was that those wonderful people, the ancient Greeks, missed four great discoveries which they seem to have been on the point of achieving—the calculus, evolution, electricity, and vaccination. As it is, the world was obliged to wait for nearly two thousand years before these little "advances" were made. It awaited the proper men. Only the other day an able biochemist told me that probably most of the facts regarding the complicated diseases of metabolism are already known, but that another Newton is required to integrate them. Such, I think, may also be the case regarding other grave medical problems, as, for example, that of cancer. Possibly the discovery may already be made, but there is no one to drag it forth into the light. In science, as in art, the man is everything.

I must make one more remark. What always amazes me is the fact that there are millions upon millions of human beings whose health and whose very existences are constantly threatened by numbers of diseases, and yet who never subscribe one farthing for the medical researches which endeavour to defeat these terrible enemies of theirs, and often succeed in doing so. Yet thousands of these same people pour out their subscriptions and bequests for all kinds of projects, many of which are futile; while even those good and generous people who maintain our hospitals and universities seem often to forget that behind hospital practice and behind university teaching there is th great science which inspires both.

I have tried to give you a brief review of what may be called the natural history of discovery. "The management of medical research" will lie in the hands of you young people; but you must study the book of the past in order to direct the advances of the future. I hope that most of you will be "mere practising doctors"; but, if so, let every afferent and efferent nerve of your thoughts connect the brain of science with every sense, muscle, and faculty of your practice. The practitioner nowadays cannot live apart from science, trying to evolve wisdom from his own meditations, like a hermit in the desert: you must not only observe, but also think; and not only think, but also read. Your first duty will be the cure or prevention of sickness; but some of you in your leisure may perhaps try to solve problems, may become enthusiasts, may even become wild enthusiasts!—I cannot imagine a nobler fate. Even, perhaps, one of you—probably not more—may be destined to become the Newton or Einstein of some hitherto undreamed-of synthesis. I hope so.

Science has indeed measured the stars and the atoms, has knit together the corners of the earth, and has enabled us to fly over oceans and deserts; but her greatest victory remains to be won. Why should we men, heirs of all the ages, continue to suffer from such mean things as diseases? Are you going to be defeated any longer by bacilli, rat-fleas, and mosquitoes? It is for you to conquer them; and remember that every gift of science is a gift not to one country or to two countries, not only for to-day or for to-morrow, but also to the whole world and for all time, until, as the poet said,

"The future dares forget the past."

The Recent Eruption of Etna.

By Prof. GAETANO PONTE, of the Etna Vulcanological Institute.

DURING the last ten years Etna has exhibited various phenomena of considerable interest, especially at the lateral crater which appeared in May 1911 on the north-eastern slope of the central cone at the 3100 metre contour. This was the forerunner of a more violent eruption in September of 1911, when the new north-east crater became more active than the central one.

In 1917 a luminous column rose like a fountain a thousand metres above the north-east crater, and about 50,000 cubic metres of very fluid lava were poured out in about half an hour, without either rumblings or shakings of the ground. This afforded most striking proof of the resistance of the structure of the volcano to the enormous forces propelling the lava, which was raised not by the force of volcanic gases, but by powerful static pressure.

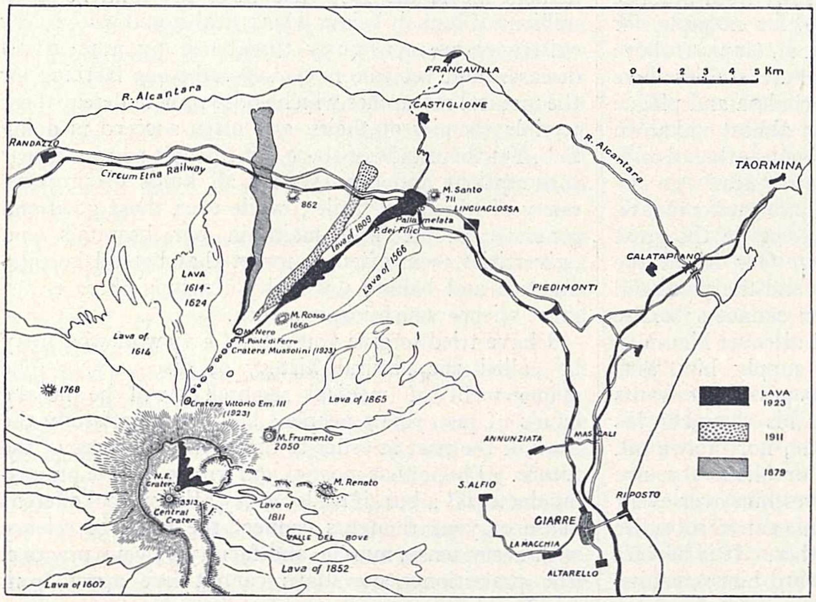


FIG. 1.—Sketch-map of north-eastern part of Etna, showing track of lava.

In June 1922 the activity of the north-east crater was resumed, and there were feeble explosions. In the spring of 1923 its activity increased still more, and at the foot of the explosion-cone which had been formed, some streams of lava appeared and spread out in short many-branched flows over the snow-fields. It was very interesting to observe the phenomenon of the hot lava spreading over the snow without melting it, but rather transforming it into ice under the weight.

The activity of the north-east crater continued until the outbreak of the eccentric eruption, which was preceded by the great explosions in the central crater, where, on June 6 last, the throat of the volcano, obstructed since 1918, reopened and ejected gigantic pine-tree clouds of reddish ash to a great height above the crater.

Following this the sky remained obscured for many days, and observations became impossible. At 2.30 A.M. of June 17 the inhabitants of the northern slope of the volcano were rudely awakened by deep rumblings and shakings of the ground, while near the craters of 1809, at the 1500 metre altitude, there rose imposing outpourings of lava; meanwhile other craters opened and other streams ran lower down the mountain, until at 4 A.M., at the 2000 m. contour on the western slope of Monte Ponte di Ferro, and at the south-western foot of Monte Nero, there were established definitely the craters of the main flow. The flow of Monte Nero, which was feeble and of short duration, ran over the bed of the 1879 lava for about 3 kilometres, but the mouth from which it flowed closed on June 21, whereas the flow from Monte Ponte di Ferro, which was of much greater extent, invaded the pine-forest of Petarrone, and, rapidly running down the eastern side of the lava-flow of 1911, reached in a few hours the Piano dei Filici, where, spreading its front, it headed towards Cerro and destroyed the vineyards and the nut-plantations of the Piano di Pallamelata (see Fig. 1).

In ten hours the lava had travelled about 7 kilometres, falling in that distance 1200 metres, but as soon as it reached the plain, as has happened in other eruptions of Etna, it slackened the speed of its advance, spread fan-wise, and swelled like the carapace of a tortoise. Thus it happened that the front of the lava, which on the evening of June 17 was about 1 kilometre from the Circum-Etna Railway, reduced its speed, and did not invade the station of Castiglione until the night of June 19.

On June 20, when the King of Italy arrived in the region devastated by the lava-flow, the front was already 1 kilometre in width, and was still advancing at a speed of from 10 to 15 metres per hour. On the following day, when the Premier, Signor Mussolini, arrived, the flow had reached the foot of Monte Santo and continued to spread out slowly like a fan, enveloping the last few houses of the Catena suburb and threatening the town of Linguaglossa. Fortunately, however, from that day the impetus of the lava began slowly to diminish, and by June 26 its rate of advance was reduced by a half. The front of the lava-flow, not being sufficiently fed from its source, stopped definitely on June 29, but on the Piano di Pallamelata, on the eastern side of the flow, a fresh branch was formed, which at first threatened to give a new direction to the devastating torrent. In the meantime, higher up on the lava-flow there were further additions and lateral outbreaks. At some points the crust of lava formed blisters, some of which, becoming solidified and remaining hollow, finally crashed in, owing to the lateral fissures. The emission of lava continued slowly until July 18, when the fiery torrent appeared to have solidified in the crater-mouth. The area covered by the lava is about three square kilometres, as estimated from the photographs taken by me from the hydroplane M. 28, kindly placed at my disposal by Signor Mussolini.

From the phenomena observed during the eruption, it can be seen that its progress was in direct relation to the mass of the lava emitted, and the various incidents were the consequences of special local conditions. If the structure of Etna were homogeneous, that is to say without hollows or fissures, the molten lava would not have departed from its principal eruptive conduit, and the eruption would have developed in the central crater. The passages which abound in the lava-flows on the slope of the volcano represent, however, so many subterranean routes which the molten lava could follow through a breach in the principal conduit, which might be formed by the simple collapse of weak parts of its walls or by breaking through where the rock was corroded by acid vapours. We do not know the changes that may have taken place along the epi-subterranean canal during the present eruption, but if its main vent near the principal eruptive conduit is still open, we can assume that with any renewed rise of the magma the lava will follow the same route. If, on the other hand, the breaches in the main pipe have been closed, the magma will reappear at the central crater until other subterranean routes are opened.

It is not possible to give a more explicit explanation of the eruption of Etna. The hypothesis of radial fractures which split the volcano at its base is not in harmony with the observed phenomena, and is contrary to the principles of the statics of liquids.

In this eruption it has been observed that the explosions were due to the detonation of explosive mixtures of volcanic gases—hydrogen, carbonic oxide, and methane—which are given off by the lava, and, when collected in subterranean cavities, form explosive mixtures with the oxygen of the air. The explosions were strongest in those parts of the fissures where deep chambers had formed in which the gases could collect, while towards the uncovered portions of the lava-canal there were milder explosions, with only small jets of lava. Later, when along this canal small cones were formed with corresponding explosion-chambers, the noises became intense. At the mouths of some of these small explosion-cones, there were often seen hissing darts of flame like those of powerful oxyhydrogen jets. These flames, due to the burning of the volcanic gases, have been observed at other volcanoes.

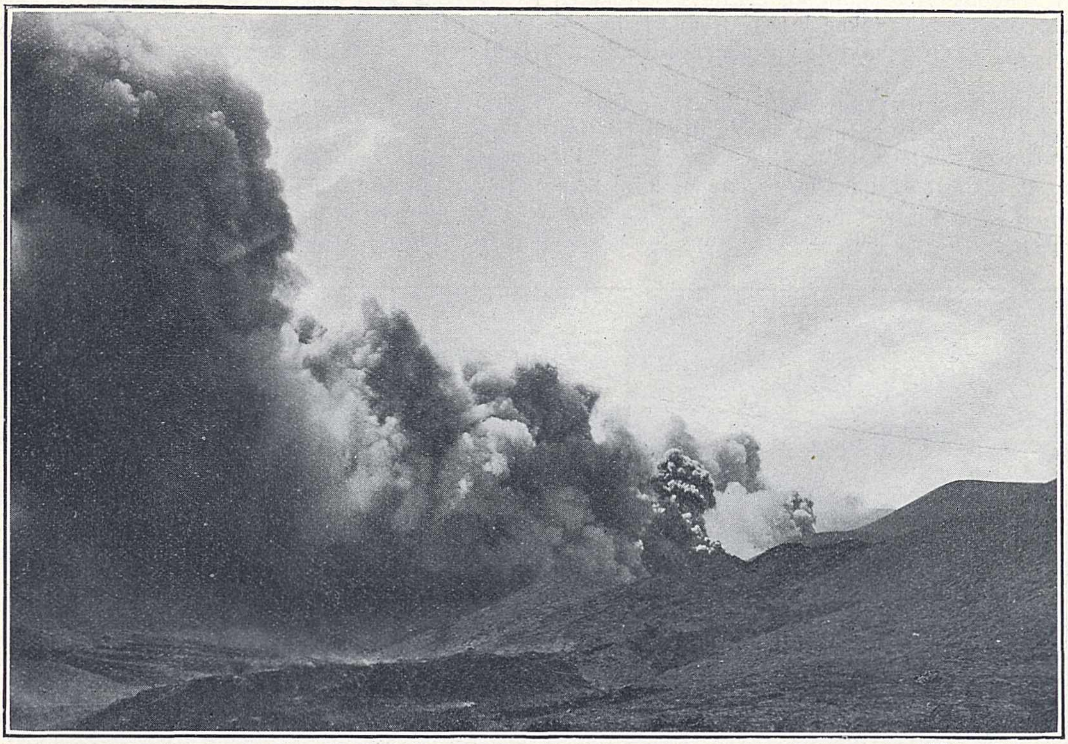
[*Photo: G. Ponte.*

FIG. 2.—The north-east crater at the beginning of the eruption of May 1923.

Various experiments were made during this important eruption. Of particular interest were the successful attempts to reduce, or even to stop for a short time, the explosions at some of the craters near their mouths by introducing carbon dioxide gas, which prevented the combustible gases from meeting with the oxygen of the air. In another experiment, nitrogen was blown through the liquid lava in order to carry away the gases given off, and to enable them to be collected without contamination by the air. This was carried out by means of a special apparatus, already described in the *Rendiconti della Reale Accademia dei Lincei*, vol. xxxi., 1922, pp. 387-389. From the repeated trials made, it was definitely proved that the gases so collected are free from water. Thus the theory of the anhydrous nature of the magmatic gases, advanced by Albert Brun, receives fresh experimental confirmation.

on the cyclonic movements caused by convection currents in the hot air over the lava-flow.

In honour of the King and the Premier, the Accademia Gioenia di Catania has given the name Vittorio Emanuele III. to the new craters in the upper part of the eruptive region, and has named those near the vent from which the lava issued Crateri Mussolini.



[*Photo: G. Ponte.*

FIG. 3.—Explosion-craters, Vittorio Emanuele III.

Many observations were made of the temperature of the lava, and it was found that this varied in different parts of the flow owing to superficial cooling in contact with the air. At a temperature of from 670° to 690° the lava was still pliable, and could be easily bent and compressed. Some interesting observations were made

Many foreign vulcanologists came to see the eruption, and among them I had the pleasure of seeing Dr. G. Kemmerling, chief of the Vulcanological Service of the Dutch Indies.

Population and Unemployment.[1]

By Sir WILLIAM H. BEVERIDGE, K.C.B.

THE impression that the civilised world is already threatened with over-population is very common to-day. Many, perhaps most, educated people are troubled by fear that the limits of population, probably in Europe and certainly in Great Britain, have been reached, and that a reduction in the rate of increase is an urgent necessity. Most, if they were asked to give reasons for their fear, would refer to one or both of two reasons: they would point to the enormous volume of unemployment in Britain; they would say that economic science, at least at Cambridge, had already pronounced its verdict. I propose to begin by raising some doubts as to the validity of each of these arguments.

The volume of unemployment in Britain is undoubtedly serious, and almost certainly unparalleled in past history. Those who see, as we now do, more than a million wage-earners whom our industry for years together is unable to absorb in productive employment may be excused if they draw the inference that there are too many wage-earners in the country. The inference, though natural, is unjustified. Unemployment in Britain can in any case prove nothing about the world as a whole. History shows that it does not prove over-population even in Britain.

During the last half of the nineteenth century, the industry of the United Kingdom was finding room for a rapidly increasing number of wage-earners with an admittedly rising standard of production and comfort. Through the whole of that period there was unemployment in the country. The percentage of trade unionists out of work never fell to zero; in no year since 1874 was it less than two; at more than one crisis it reached a height comparable if not equal to that which we have

[1] From the presidential address delivered to Section F (Economic Science and Statistics) of the British Association at Liverpool on September 17.

just experienced. During 1922 this percentage has averaged fifteen; but it averaged over eleven in 1879 and over ten in 1886. These figures are not on an identical basis, and are therefore not absolutely comparable. Taken for one year only, they understate the relatively greater seriousness of our recent experience, since the unemployment percentage was high through a large part of 1921 as well as in 1922, and still continues high. But the difference is one of degree rather than of kind. The peril of inferring over-population from unemployment is conclusively shown.

The experience of 1879 was up to then unparalleled; probably it was as much worse than anything previously recorded as the experience of 1922 appears worse than that of 1879. The experience of 1879, however, the record year of unemployment, heralded, not over-population and the downfall of British industry, but a period of expansion and prosperity which reached, if it did not pass, all previous records. "Real wages," which had risen thirty per cent. in the twenty years to 1880, rose even more rapidly in the next twenty years to 1900. Any one who in 1879, looking at the half or three-quarter million unemployed, had argued that the existing population of the United Kingdom (then about thirty-four millions) was all that the country could support without lowering its standards, would have been lamentably discredited at once. Ten years later he would have found a population nearly three millions more, enjoying a real income per head that was a fifth greater, with the unemployment percentage reduced to two. Ten years later still the population had grown further in size and in prosperity; those trades had grown most rapidly in which there had been and continued to be the largest percentages of unemployment.

The problems of unemployment and of over-population are distinct; they are two problems, not one. Severe unemployment has occurred in the past without over-population, as a function of the organisation and methods of industry, not of its size. On the other hand, it is very doubtful if excessive growth of population has ever shown itself or would naturally show itself by causing unemployment. A more probable effect would be pressure to work more than before in order to obtain the same comforts: a fall of real wages per hour, by increase either of hours or of prices.

The same dependence of unemployment on the organisation and methods of industry, rather than on its size, appears if we look, not backwards in time, but round us in space. It has been pointed out by Prof. Cannan that one of the few groups of economists who from our post-War sufferings can at least obtain the high intellectual satisfaction of saying "I told you so," is that which maintains that changes in the purchasing power of money are the most potent causes of the fluctuations in prosperity known as cycles of trade or booms and depressions. "In the pre-War period booms and depressions swept over the whole western world at once and left their causes obscure. In 1922 we have been treated to a sharp contrast between two groups of countries, one group having boom and full employment, the other depression and unemployment, the difference being quite clearly due to the first group having continued the process of currency inflation, the other group having dropped it." To bring this generalisation down to particular examples, we see in Central Europe a nation which assuredly should be suffering from over-population if any nation is; Germany, defeated in war, has been compressed within narrower limits, has lost its shipping and foreign investments, its outlets for emigration and trade, and now by high birth-rates is repairing with exceptional speed the human losses of the War. Germany may or may not be suffering from over-population. She certainly has not suffered from unemployment; she has had a boom stimulated by inflation of the currency. We see on the other hand Britain, victorious in war, with expanded territories and the world open to her, pursuing a different, no doubt a better, currency policy, and experiencing unexampled unemployment. To argue uncritically from unemployment to over-population is to ignore the elements of both problems.

. . . .

In regard to Europe as a whole we find no ground for Malthusian pessimism, no shadow of over-population before the War. Still less do we find them if we widen our view to embrace the world of white men. The fears expressed by Mr. Keynes in his book "Economic Consequences of Peace" seem not merely unnecessary but baseless; his specific statements are inconsistent with facts. Europe on the eve of war was not threatened with a falling standard of life because Nature's response to further increase in population was diminishing. It was not diminishing; it was increasing. Europe on the eve of war was not threatened with hunger by a rising real cost of corn; the real cost of corn was not rising; it was falling.

. . . .

For Europe and its races the underlying influences in economics were probably still favourable when the War began. But the war damage was great, and we are not in sight of its end. Man for his present troubles has to accuse neither the niggardliness of Nature nor his own instinct of reproduction, but other instincts as primitive and, in excess, as fatal to Utopian dreams. He has to find the remedy elsewhere than in birth control.

Let me add one word of warning before I finish. Such examination as I have been able to make of economic tendencies before the War yields no ground for alarm as to the immediate future of mankind, no justification for Malthusian panic. It has seemed important to emphasise this, so that false diagnosis should not lead to wrong remedies for the world's sickness to-day. But the last thing I wish is to over-emphasise points of disagreement with Mr. Keynes. The limits of disagreement are really narrow. The phrases that I have criticised are not essential to Mr. Keynes's main argument as to the consequences of the War and the peace. Whether Mr. Keynes is right or, as I think, too pessimistic as to economic tendencies before the War, he will, I am sure, be regarded as right in directing attention again to the importance of the problem of population. Nothing that I have said above discredits the fundamental principle of Malthus, reinforced as it can be by the teachings of modern science. The idea that mankind, while reducing indefinitely the risks to human life, can, without disaster, continue to exercise to the full a power of reproduction adapted to the perils of savage or pre-human days, can control death by art and leave births to Nature, is biologically absurd. The rapid cumulative increase following on any practical application of this idea would within measurable time make civilisation impossible in this or any other planet.

In fact, this idea is no more a fundamental part of human thought than is the doctrine of *laissez faire* in economics, which has been its contemporary, alike in dominance and in decay. Sociology and history show that man has scarcely ever acted on this idea; at nearly all stages of his development he has, directly or indirectly, limited the number of his descendants. Vital statistics show that the European races, after a phase of headlong increase, are returning to restriction. The revolutionary fall of fertility among these races within the past fifty years, while it has some mysterious features, is due in the main to practices as deliberate as infanticide. The questions now facing us are how far the fall will go; whether it will bring about a stationary white population after or long before the white man's world is full; how the varying incidence of restriction among different social classes or creeds will affect the stock; how far the unequal adoption of birth control by different races will leave one race at the mercy of another's growing numbers, or drive it to armaments and perpetual aggression in self-defence.

To answer these questions is beyond my scope. The purpose of my paper is rather to give reasons for suspending judgment until we know more. The authority of economic science cannot be invoked for the intensification of these practices as a measure for to-day. Increased birth control is not required by anything in the condition of Europe before the War, and is irrelevant to our present troubles. But behind these troubles the problem of numbers waits—the last inexorable riddle for mankind. To multiply the people and not increase the joy is the most dismal end that can be set for human striving. If we desire another end than that, we should not burk discussion of the means. However the matter be judged, there is full time for inquiry, before fecundity destroys us, but inquiry and frank discussion there must be.

Two inquiries in particular it seems well to suggest at once. The first is an investigation into the potential agricultural resources of the world. There has been more than one elaborate examination of coal supplies; we have estimates of the total stock of coal down to various depths in Britain and Germany, in America, China, and elsewhere; we can form some impression of how long at given rates of consumption each of those stocks will last; we know that "exhaustion" is not an issue for this generation or many generations to come. There has been no corresponding study of agricultural resources; there is not material even for a guess at what proportion of the vast regions—in Canada, Siberia, South America, Africa, Australia—now used for no productive purpose, could be made productive; and what proportion of all the "productive" but ill-cultivated land could with varying degrees of trouble be fitted for corn and pasture. Without some estimate on such points, discussion of the problem of world population is mere groping in the dark. The inquiry itself is one that by an adequate combination of experts in geographic and economic science—not by a commission gathering opinions or an office gathering statistical returns—it should not be difficult to make.

The second is an investigation into the physical, psychological, and social effects of that restriction of fertility which has now become a leading feature of the problem. This also is a matter neither for one person—for its scope covers several sciences—nor for a commission; facts rather than opinions or prejudices are required.

If the question be asked, not what inquiries should be made but what action should now be taken, it is difficult to go beyond the trite generalities of reconstruction, of peace and trade abroad, of efficiency and education at home. The more completely we can restore the economic system under which our people grew, the sooner shall we absorb them again in productive labour. Unless we can make the world again a vast co-operative commonwealth of trade, we shall not find it spacious enough or rich enough to demand from Great Britain the special services by which alone it can sustain our teeming population. Even if the world becomes again large enough to hold us, we shall not keep our place in it with the ease of Victorian days; we dare no longer allow, on either side of the wage bargain, methods which waste machinery or brains or labour. Finally, if there be any question of numbers, if there be any risk that our people may grow too many, the last folly that we can afford is to lower their quality and go back in measures of health or education. Recoil from standards once reached is the gesture of a community touched by decay.

Obituary.

MR. FREDERICK CHAMBERS.

THE death is announced of Mr. Frederick Chambers, late Meteorological Reporter for Western India, at the age of seventy-seven years. Mr. Chambers was the younger brother of Charles Chambers, who went out from Kew Observatory in 1864 to take charge of the Colaba Observatory, Bombay. Frederick went out as assistant to his brother. In 1873 his paper, "The Diurnal Variation of the Wind and Barometric Pressure at Bombay," was published in the Phil. Trans. of the Royal Society, and another paper, "Mathematical Expression of Observations of Complex Periodical Phenomena; Planetary Influence on the Earth's Magnetism," written in collaboration with his brother, appeared in the Phil. Trans. in 1875. About this time Mr. Chambers was appointed Meteorological Reporter for Western India. A quotation from the first annual report which he printed is not without interest. It is explained that meteorological instruments had been sent out from England in 1852, "the duty of making the observations at those places being imposed on the senior medical officers"; the comment is made, "We would hope that from the zeal and energy of medical officers in charge of European hospitals and their love of science, the observations may be made by themselves and their establishments, without entailing on the public any expense on this account."

The zeal and energy of the medical officers, and their love of science, however, seem not to have been equal to the occasion, for after vainly endeavouring, until the end of 1855, to carry out the orders they had received, without entailing expense on the public, it was arranged, at the direction of the Honourable Board, that two European soldiers should be told off at each station to undertake the duty of making meteorological observations on an allowance of 25 rupees per month for each observatory. The soldiers were sent to the Bombay Observatory early in 1856 for a preparatory course of training, on the successful completion of which they were furnished with certificates of competency to perform the work. Soon after this time the real work of meteorological registration may be said to have commenced, for, so far as the observers are concerned, the work from this time appears to have been carried on generally in a thorough and satisfactory manner. Under Mr. Chambers's administration the instruments were for the first time regularly compared with standards, and trustworthy data, such as made the Climatological Atlas of India possible, were collected.

DR. CHRISTIAN HESS.

ONE of the directors of the Farbenfabriken vorm. Friedr. Bayer und Co., in Leverkusen, Dr. Christian Hess, died on July 11 in Bonn, after a serious operation. He was born January 14, 1859, at Eisenach, studied chemistry first at Jena and then in Berlin, where he worked for his doctorate under A. W. v. Hofmann in 1881. After having been assistant chemist to Prof. Wichelhaus at the Institute of Chemical Technology, he went in 1883 to the newly founded weaving, dyeing, and finishing school in Crefeld, where he developed very great activity as a teacher and an expert adviser. At that time he invented his process for removing iron from water. The large number of coal-tar dyestuffs of a new character, which were discovered at that time, brought with them the necessity of using new methods for dyeing. This caused a lot of difficulties in the dyeworks, to meet which the dyemakers engaged colourists of good chemical training, able to introduce the new methods. One of the first of these was Dr. Hess, who was engaged by the Farbenfabriken in 1894.

Dr. Hess showed remarkable commercial ability, and after some time the whole of the sale of dyestuffs was entrusted to him; he was nominated a director in 1906. His knowledge of men and things enabled him to render many important and lasting services to the industrial side. His firm, his colleagues, his employees and the great number of men he helped with good advice, with sound reasoning and with hearty encouragement, when in difficulties, will much regret his premature death.

PROF. J. VIOLLE.

THE issue of the *Revue scientifique* for September 22 contains a notice of the death of Jules Violle, professor of physics at the Conservatoire des Arts et Métiers, which occurred at Fixin, near Dijon, on September 12. Violle was born in the same district on November 16, 1841. After obtaining his doctorate in 1870, he was in succession professor of physics at Grenoble, at Lyons, and at the École Normale. In 1897 he was elected a member of the Paris Academy of Sciences in succession to Fizeau. He was president of the French Physical Society, of the Society of Electricians and of the Committee of Inventions for National Defence. His earliest research was a determination of the mechanical equivalent of heat by means of the Foucault currents in a disc rotating in a magnetic field. His result, about 4 per cent. too high, was published in 1870. His work on the temperature of the sun appeared in 1877, and in 1884 he proposed as a standard of light, that radiated normally by a sq. cm. of molten platinum at its freezing-point. From 1886 to 1905 he published in conjunction with Vautier a number of memoirs on the speed of sound particularly in tubes. His "Cours de physique," which began to appear in 1883, was never completed.

WE regret to record the death, on July 26, of Alexander Ellinger, professor of pharmacology in the University of Frankfort. Before the foundation of the latter university Ellinger held a similar chair at Königsberg. He was best known for his chemical work. Thus he showed that ornithine and lysine are decarboxylated by bacteria to putrescine and cadaverine respectively. He supplied the final touches to the determination of the constitution of tryptophane, and synthesised this amino-acid. Its transformation to kynurenic acid by the animal organism occupied much of his attention, and a few years ago he was able to elucidate the mechanism of this peculiar change, which apparently takes place via the keto-acid corresponding to tryptophane.

THE Brooklyn Museum Quarterly of July includes an obituary notice of Prof. William Henry Goodyear, best known by his work entitled "The Grammar of the Lotus," who died in February last aged seventy-seven. The theory developed in this book was conceived during his studies of lotiform decorations in Cypriote art, and included a study of the lotus in the decorations on peat from early Egyptian times. In his work as an architect his discoveries of architectural refinements will prove most important. His published work is extensive and valuable, and is fully recorded in the sketch of his career by Mr. W. S. Conrow.

WE regret to announce the following deaths:

Sir Halliday Croom, emeritus professor of midwifery at the University of Edinburgh and lately president of the Royal College of Surgeons, Edinburgh, on September 27, aged seventy-six.

Dr. P. Friedländer, professor of organic chemistry and of organic-chemical technology at the Darmstadt Technical College, aged sixty-six.

Dr. Herbert McLeod, F.R.S., honorary director of the Royal Society Catalogue of Scientific Papers, on October 1, aged eighty-two.

Current Topics and Events.

PROF. LYDE's leading article in last week's NATURE points to the need for a scientific basis for any programme aiming at the development of Empire resources which may result from the deliberations of the Imperial Economic Conference. A satisfactory organisation for effecting this purpose should embrace three main lines of work, namely, the exhibition of Empire raw materials, the technical examination of "new" or little-known products, and the systematic collection and dissemination of information relating to raw materials, their marketing and industrial use. An organisation originally designed for the purpose exists in the Imperial Institute. The Public Exhibition Galleries provide what is unobtainable elsewhere, namely, a permanent exhibition, under one roof, of the resources of all the countries of the Empire, so organised that a visitor desiring special information is, on inquiry, referred to the appropriate department of the Institute. These collections should be of great value to the business man, and their educational importance to the university student, no less than to the scholars who visit the Galleries in large numbers, conducted by the official guide, is obvious. Special lectures for the general public are also given by recognised authorities. The complement of the collections is the Scientific and Technical Department, the investigations of which—specially planned to meet the needs of the case—in conjunction with the assistance of the technical and commercial committees of the Institute, have served the economic development of the Empire to a degree unsuspected by the general public. The essential link in the scheme, namely, the collection and dissemination of technical and other information, and an organisation for dealing with the constantly growing stream of inquiries, exists in the Technical Information Bureau, which forms the intelligence department of the Institute and has proved of great practical service.

OUR famous medical contemporary, the *Lancet*, began its hundred and first year of publication on October 6, when a supplement was issued of nearly eighty pages, profusely illustrated by the portraits of many distinguished friends and some of the equally distinguished enemies of the paper. The text, modestly and humorously written, is a truly remarkable record of facts in medical highways and byeways during the past century. It is not too much to say that the present state of medical education and practice in England, its established efficiency and security and freedom from all grave abuses, is as much due to Thomas Wakley's *Lancet* as to anything else. Its scurrilities, venomous nick-names—"little eminent"—the rollicking old libels, semi-caricatures, "intercepted letters," and grandiloquent but downright abuse in plain English are now things past regret. Wakley's handling of them was perfectly in accord with his time; while his sense of right, his courage, and his devotion to a great cause would receive high admiration in our own. In the first ten years of his paper's existence there were six actions for libel, the aggregate sum of 8000*l*. being claimed for damages; the aggregate of 155*l*. 0*s*. 0¼*d*. was awarded, the editor's costs being largely defrayed by public subscription. The design of the paper was to supply medical information which was available at that time to but few people, and to show that hospitals were not served, and that students were not trained, by persons selected for their merits. The libel actions arose out of the publication of supporting evidence, and ceased as reforms followed. Wakley's accusations of nepotism in hospital management and malpraxis in hospital practice gained public hearing in the Bransby Cooper case. His campaign against the Royal College of Surgeons of England, at first mismanaged, resulted in the appointment, in 1834, of Warburton's Parliamentary Committee of Inquiry into the state of the medical profession, and, later, in the Act constituting the General Council. Since then, lunacy, food adulteration and water-supply, workhouse administration, the advancement of Lister's views and of anæsthetic technique, and, indeed, every notable contribution by science to medicine, have in turn provided the *Lancet*, under Wakley guidance, with fields for great constructive work. The Centenary Supplement is a document of absorbing interest, personal and professional, a becoming memorial to great Englishmen.

MR. W. J. U. WOOLCOCK, the General Manager of the Association of British Chemical Manufacturers, described to representatives of various technical journals on Monday last the progress which has been made with the preparation of the Chemical Section of the British Empire Exhibition to be held at Wembley next year. The Chemical Section, which is being organised by the Association, and occupies nearly 40,000 square feet in the Palace of Industry, will be built in such a way as to form a Hall within the Palace. About 100,000*l*. will be spent in presenting to the public a picture of the present state of British chemical industry. No important firm in the industry will be unrepresented, and the whole of the individual exhibits, numbering about one hundred, will, by reason of their position and character, combine to form a magnificent illustration of the industry. Considerable attention has been paid to the lay-out and to the decoration of the Chemical Hall. There will, for example, be about two hundred yards of a specially painted frieze illustrating various operations in chemical manufacture; and as the majority of the stands are being designed by the same architect, the treatment of each stand is likely, while maintaining the individuality of the occupier, to present a very pleasing picture of the Hall as a whole. In the centre of the Chemical Hall there is to be illustrated the progress which has been made in pure chemistry during the past twenty or thirty years, with the view of showing that the stream of scientific invention in this country is still flowing steadily onwards. The Scientific Section is being organised by a Committee consisting of representatives of the following bodies: The Chemical Society, the Institute of Chemistry, the Societies of Chemical

Industry and of Dyers and Colourists, the Pharmaceutical Society, and the Institutions of Petroleum Technologists and Chemical Engineers. The Committee is working in close co-operation with the Royal Society. Sir Herbert Jackson acts as the representative of the Royal Society on the Committee and Mr. Woolcock in a similar capacity on the Royal Society Committee. In order that both the general public and scientific persons may have a record of the exhibit, it is proposed to publish a number of pamphlets specially written for the purpose dealing in popular language with the various classes of exhibits in the Scientific Section. In addition to this it is proposed to publish in more technical language a work, which will not only explain the scientific exhibits, but will put on record in a very complete form the state of our knowledge in chemical matters at the date of the Exhibition. It is anticipated that there will be a very large demand for this valuable record, each chapter of which will be contributed by an authority in the subjects dealt with, and that it is likely to find a place on the bookshelf of every scientific worker.

IN the hope of checking the rabbit pest in Australia, it is proposed by the Commonwealth to make large advances, not exceeding 250,000*l*., to cover the cost of supplying settlers with wire netting on easy terms. Every State would get a fair proportion of the netting. The second reading of the bill has been carried in the House of Representatives. The money is to come out of the Consolidated Revenue Fund, and its amount indicates the continued seriousness of the situation. In the course of the discussion in the House it was mentioned that thousands of acres, in South Australia in particular, had depreciated to half their value owing to the rabbit pest, and it was stated that whereas in 1893 there were 60,000,000 sheep in New South Wales, the number was now down to 32,000,000 because of the rabbits. The calamitous interference with the balance of Nature involves a vicious circle, for the hope of permanent relief is increase in the agricultural population so that concerted and widespread elimination may be organised, but this increase is checked because the rabbits tend to make the settlers' work economically hopeless. Trapping and poisoning, netting and inoculation, have been tried with persistence, but the prolific multiplication of the rabbit continues to defeat man's efforts. Attention is being re-directed to the Rodier method, which has proved effective in areas of considerable size. Mr. W. Rodier suggested that doe-rabbits should be killed in as large numbers as possible, but no bucks. In the areas experimented with, the result was that the bucks killed the helpless young and also that the does were persecuted to death by the demands of the bucks. In other words, the polyandry became so intense that the females perished in large numbers. The method has experimental facts in its favour, and it is applicable to other pests such as rats and sparrows. A practical difficulty is in distinguishing the sexes before the act of killing.

WE regret to learn that on the afternoon of September 20, a violent explosion followed by fire occurred in the Dynamometer Laboratory of the Bureau of Standards, Washington, D.C. One man was killed instantly, three others injured so seriously that they died during the night, and four others seriously burned or cut. The heroism of the survivors of the staff in rescuing the injured from the furiously burning wreckage and in shutting off the electric circuits and the ammonia valves, minimised the loss of life and property. The explosion occurred in the altitude chamber which is used in testing the performance of aircraft engines under the conditions of low pressure and temperature obtaining at high altitudes. At the time of the accident the room was being used in investigating the performance of an automobile engine, at temperatures corresponding to winter operation, using various grades of gasoline. The work was intended to determine the possible increase in gasoline production per barrel of crude oil, with the accompanying conservation of oil resources,by the use of gasoline of lower volatility. The explosion was due to the ignition of an explosive mixture in the chamber. The men who were killed are: Logan L. Lauer, Urban J. Cook, Stephen N. Lee, and Joesph Kendig; while those injured are: Henry K. Cummings, Frank E. Richardson, Roger Birdsell, George W. Elliott, C. N. Smith, and R. F. Kohr. Most of these men were college graduates with experience and skill in research work, and a grave blow to science and engineering must be added to the human loss to their families and colleagues. Thus grows the long list of those who have given their lives for the increase of human knowledge and welfare.

THE first number of an important and interesting publication, *The British Journal of Experimental Biology* (Edinburgh: Oliver and Boyd. Quarterly, 12*s*. 6*d*. net; annual subscription, 40*s*. net) has recently been issued from the Animal Breeding Research Department of the University of Edinburgh, with Dr. F. A. E. Crew as editor in chief. The experimental method has become so indispensable in biological research that it is perhaps remarkable that no special journal has hitherto been devoted in Great Britain to its results, though America and Germany have long possessed such media of publication. The British journal, however, covers a wider field than any existing publication, as is sufficiently evident from the fact that the contributions to the first number are drawn from such diverse institutions as the Animal Breeding Research Department, Edinburgh, the Zoological Departments of the Universities of Edinburgh and Oxford, the Physiological Department of the University of Oxford, and the Natural History Department of the British Museum. Of late years there has been a strong tendency towards over-specialisation among working biologists and the new journal should do good service in promoting the unification of biological science. We are glad to note that it is the intention of the editors to publish regular reviews of recent progress in different fields of research; the critical summary on that very modern branch of biological science known as tissue culture, by H. M. Carleton, which appears in the present number, shows how valuable a feature such reviews are likely to be. The journal is very attractive in appearance; both letter-press and illustrations are excellent and the price is moderate. We wish it all success, and especially a large body of subscribers.

"THE Natural History of Wicken Fen," Part I. (Cambridge: Bowes and Bowes), which is to continue appearing until the volume is completed, under the general editorship of Prof. J. Stanley Gardiner and Mr. A. G. Tansley, is a very desirable record of public-spirited action by entomologists and botanists, supported by the National Trust for Places of Historic Interest or National Beauty. The Trust now holds for the benefit of the nation 521 acres, which include the greater part of the old undisturbed fenland in Wicken Sedge Fen, St. Edmund's Fen, and Burwell Fen, and has obtained leases of other areas. Mr. A. H. Evans, the secretary of the local committee formed in Cambridge in 1914 to further the purchase and preservation of the fenland, states that the Trust is able to look forward with confidence to the early purchase of a further 60 or 70 acres if funds are available. Mr. Evans reports that "very little more remains to be done in this direction," an eminently satisfactory state of affairs for which we have to thank many generous donors, but notably the late Mr. G. H. Verrall, of Newmarket, an ardent entomologist who realised the value of the undisturbed fenland to the student of insect life. The volume now commenced is to place on record the history and the biology of the fenland, and the present part contains Mr. Evans's history of the fens, with especial reference to Wicken Fen, and of their drainage and its effect upon the fauna and flora, together with an account of the butterflies and moths of Cambridgeshire by W. Farren, which is substantially the same as that appearing in the British Association Handbook for 1904. The local committee has wisely decided not to leave the fen "to Nature," which, as the secretary points out, would mean eventually the formation of a tangled impenetrable thicket of the tall coarse sedge (*Cladium Mariscus*) shaded by alien trees, but to see that excessive growth is thinned out and the waterways kept so that the winter floods may profit the ground. The characteristic fen country has never been an untouched wilderness, but so far back as its history is known the sedge crop has regularly been cut, being once of considerable value.

SIR E. SHARPEY SCHAFER is to deliver the first Victor Horsley Memorial Lecture at the Royal Society of Medicine on Thursday, October 25, at 5 o'clock, taking as his subject "The Relations between Surgery and Physiology."

THE sixth annual Streatfeild Memorial Lecture will be delivered in the Chemical Lecture Theatre of the Finsbury Technical College, Leonard Street, E.C.2, at 4 o'clock on Thursday, October 25, by Mr. E. M. Hawkins. The subject will be "Analytical Chemistry," and admission will be free.

THE eighth annual meeting of the Optical Society of America will be held at Cleveland, Ohio, in the Case School of Applied Science, on October 25-27. The address of the retiring president, Dr. L. T. Troland, will be on "The Optics of the Nervous System." Prof. A. A. Michelson will read, by invitation, a paper on "The Limit of Accuracy in Optical Measurement," and Mr. F. A. Whiting, director of the Cleveland Museum of Art, will address the Society on "The Optical Problems of an Art Museum." A number of papers on general optics, vision, colorimetry, photometry, spectroscopy and instruments will also be presented.

THE programmes for the meetings of the Royal Microscopical Society during the coming winter session have been issued, and the Society is to be congratulated on the excellent series of papers and communications which will be submitted for discussion. The section dealing with the industrial applications of the microscope has a specially attractive list, and in addition to the large number of exhibits, the practical demonstrations shown will be a leading feature at each meeting. Arrangements have been made for communications and discussions dealing with coal, petrology, metallurgy, textiles (cotton and linen), paper, bee-keeping, and poultry-keeping. A further attraction of the meetings of the Industrial Applications Section will be a series of lecture demonstrations, which will embody a practical course of instruction in the manipulation of the microscope. These will be given by Mr. J. E. Barnard, and a detailed syllabus of the same will be forwarded on application to the secretary to the Society, 20 Hanover Square, W.1.

THE latest news of Mr. K. Rasmussen's expedition to Arctic Canada has been brought to Europe by Mr. Birket-Smith, who has returned to Copenhagen. According to the *Times*, Mr. Rasmussen had reached Pelly Bay, near the Magnetic Pole, at the end of April on his way to Alaska and Siberia in his endeavour to trace the route of Eskimo migrations. Mr. P. Freuchen is following the Eskimo track via Baffin Land, Lancaster Sound and Ellesmere Land to Thule in north-western Greenland. Mr. Birket-Smith completed his task of visiting the inland Eskimo tribes in Melville Peninsula and Rae Isthmus.

THE *Times* publishes an account of the travels in Spitsbergen last August of the Merton College expedition. The original project of exploring North-East Land had, as was fully expected, to be abandoned. It is far beyond the scope of a summer visit. The vessel carrying the party was able to penetrate Hinlopen Strait from the north, land a sledging party on the western shore and reach Ulve Bay on the south coast of North-East Land. On the pack closing in, a retreat was made northward along the strait and a brief visit was paid to the north coast of North-East Land. Pack ice prevented progress beyond Cape Brunn and the vessel was forced to return. After a visit to Klaas Billen Bay, where the sledging party was picked up at Camp Bruce, the expedition returned to Norway. On the west side of North Cape was found a canvas tent bag which has been identified as a relic of the German Expedition of 1912 and doubtless belonged to Lieut. Schroeder Stranz, who lost his life in an attempt to sledge over insecure sea-ice.

BIBLIOGRAPHY of meteorological literature, No. 4, has recently been issued by the Royal Meteorological Society, having been prepared with the collaboration of the Meteorological Office. It deals with all meteorological publications and articles on meteorology recently received, giving the titles and references where the literature is to be found. The division of the subject-matter under specified heads enables a would-be student to determine the helpful line of reading which he is desirous of prosecuting, without loss of time. Divisions are given for the several meteorological elements, such as atmospheric pressure, temperature, solar radiation, aqueous vapour and cloud, rain, wind, storms, and weather forecasting, with other allied subjects.

WE have received a copy of the Report of the Proceedings of the Natural History Society of Bishop Stortford College for 1922. It is the first report published by the Society, and contains a list of the plants found in the district during the years 1920–1922, an account of the more interesting Lepidoptera occurring during 1922, and a note on the birds of the year. A list of the more important additions to the school museum during the year and a general account of the activities of the Society, especially in the maintenance of vivaria and aquaria, are added. The successful attempt to induce the viper to breed in captivity is a notable achievement. The Society can be congratulated on having got together a nucleus of enthusiastic and active workers, and we hope the publication of this report will stimulate its members to increased and more sustained work on the fauna and flora of the district.

WE have received from Messrs. Watson and Sons, Bulletin 29 S. on diathermy apparatus. The introductory remarks are reprinted from an article by Dr. E. P. Cumberbatch, who has made important contributions to this subject. This foreword explains clearly the methods which are necessary for the production of sustained oscillations of the right frequency for the purposes in view, and also gives some account of the surgical and medical uses to which the diathermy currents can be put. The early designs of the instrument have been much improved so as to allow a large output of these currents, and the spark gap, which has often proved the weakest feature of the instruments, is now run in an atmosphere of coal gas; if this is not available, petrol or acetone may be used. The bulletin is illustrated by various parts of these machines and by a great variety of electrodes for the various cavities of the body.

THE Cambridge University Press announces the forthcoming publication of "The Archæology of the Cambridge Region," by C. Fox, which will form a topographical study of the bronze, early iron, Roman, and Anglo-Saxon ages, with an introductory note on the neolithic age. The object of the work is to provide a basis for future detailed study, period by period, of the archæological remains of the district and of the many problems connected with them.

Our Astronomical Column.

PHOTOGRAPHIC MAGNITUDES OF SATELLITES OF JUPITER.—Mr. Seth B. Nicholson has made a careful study by photography of the magnitudes of the eighth and ninth satellites of Jupiter. Reduced to mean opposition they are 17·6 mag. and 18·6 mag. respectively. Assuming albedoes similar to that of Jupiter III (Ganymede), the diameters are about 30 miles and 20 miles.

PERTURBATIONS BY THE METHOD OF QUADRATURES.—In 1908, Dr. P. H. Cowell introduced the method of following the perturbed motion of a planet or comet by calculating the forces acting in three directions mutually at right angles, and so obtaining the second differences of the x, y, z co-ordinates of the body; being given the initial values, the successive ones are then formed by addition of the differences.

Mr. B. V. Noumeroff has lately improved the method in a paper in vol. ii. of Publications de l'Observatoire Astrophysique de Russie. Mr. Commendantoff contributes a paper to *Astr. Nach.*, No. 5249, explaining the method and applying it to form positions of Ceres from 1913 to the present time. The Nautical Almanac has discontinued its ephemeris of the four bright asteroids, and since then regular ephemerides have not been available.

The point of the method is the use of new coordinates formed from x, y, z by multiplying them by a factor so chosen that the differences between the second and the sixth disappear, which greatly simplifies the calculation. The first approximation, using Jupiter perturbations only, at 40-day intervals, represents the place of Ceres for ten years with no error exceeding 15 seconds of time, which is sufficient for a finding ephemeris; it is further shown how the calculated co-ordinates may be improved when later observations are available. The method appears to be worthy of careful study.

STUDIES IN STELLAR MASSES.—Many recent studies in this field have been mentioned in this column. Dr. E. Hertzsprung contributes another to Bulletin No. 43, Astron. Instit. of Netherlands. He classifies 14 pairs of known orbit elements and parallax; they include the interferometer results for Capella and the eclipsing variable β Aurigæ; the mass of each component is deduced and the logarithm of the mass plotted against the quantity $m+5 \log p$, where m and p are the apparent magnitude and parallax respectively. The graph connecting the two is nearly linear, showing a close correlation between mass and absolute magnitude, a result reached by other investigators. An expression using first and second powers of log mass is preferred, as it gives a better fit; it is noted that the formula fits well for the sun.

A table is given enabling the parallax to be deduced when the magnitudes and orbit elements are known. The star ζ Orionis is discussed. This star has a motion in position angle of 1° in 9 years, but the arc described is too short for finding an orbit. Jackson found the hypothetical parallax 0·016″ assuming a mass double that of the sun. The parallax found from the new formula is 0·0038″, which is regarded as more trustworthy. It agrees well with other estimates of the distance of the Orion group.

Dr. Hertzsprung appeals to parallax observers to pay special attention to stars the orbit elements of which are either known or are likely to be determinable before long.

Research Items.

FIRE-MAKING ON THE GOLD COAST.—In the September issue of *Man*, Mr. A. W. Cardinall describes the use of the flint and steel in fire-making in the northern territories of the Gold Coast. The tinder used is cotton from the kapok, and is carried about in all sorts of receptacles—cotton or leathern bags, or more rarely in the more primitive way in the hollowed-out seeds of the fan-palm. Only one case of sacred fire is recorded where the fire is maintained, more or less permanently, outside the chief's compound: there is no special rite observed in lighting it, but no one may take fire from it. The fuel used is dried cow-dung, and in the rains the fire is allowed to go out. Sacrifices are made to it, some of the blood and bones of the victims being placed in a pot laid on the top of the fire. Only the chief and one other man, not identified, are allowed to eat the flesh of the sacrifice.

THE OCCURRENCE OF THE LIZARD IN MAORI CARVINGS.—In the *New Zealand Journal of Science and Technology*, March, 1923, Mr. Elsdon Best of the Dominion Museum notes that one of the remarkable features of Maori carved work is its lack of natural forms, particularly of the local flora. Some animals are delineated, but none so faithfully resembling the original as the lizard. The type known as Manaia seems to have been confused with the lizard, possibly because this is one meaning of the word, but the Manaia form is really the old Indian motif of Vishnu flanked by two Garudas, the powers of Good and Evil. Mr. Best thinks it probable that the introduction of the lizard or crocodile into carved designs originated in the western Pacific, possibly in Indonesia. He gives numerous examples of superstitions connected with lizards, one being that the Maori is said to believe that the spirits of his ancestors revisit the earth in the form of lizards. This may to some extent account for its introduction into Maori art.

HAWAIIAN LEGENDS.—A collection of Hawaiian legends by William Hyde Rice forms Bulletin No. 3 of the Bernice Pauahi Bishop Museum at Honolulu. The narrator is the son of missionaries who arrived in Hawaii in 1840, and he has been familiar with the Hawaiian language since his earliest childhood. He has been a member of the House of Representatives, and a Senator, and was Governor of Kauai under Queen Liliuokalani until after the revolution of 1898. The legends are fairy tales pure and simple with no underlying mythological meaning. They were told by the bards or story-tellers, either itinerant or attached to the courts of the chiefs, where alone the stories were to be heard. Some had historical foundations now forgotten, others were efforts of the imagination. Some of these legends Mr. Rice remembers having heard as a boy, and places mentioned in the stories were pointed out to him. Among the legends are those of Pele the fire-goddess, the Rainbow Princess, and Ulukaa the rolling island. Another tells of the Menehune, mythical dwarfs only two or three feet high, who were tremendously strong but ugly of face. They were credited with all sorts of magical powers and perfect skill, but would only work one night on any construction. If not completed it was left undone. Other stories are those of Kawelo the hero of Kauai, of Paakaa and his son Ku-a-paakaa, of Kana the strong, of the beautiful Kaili-lau-o-kekoa and of Makuakaumana, the man who was swallowed by a big fish, and several others. A glossary of Hawaiian terms with notes is given as an appendix, and a portrait of Mr. Rice forms a frontispiece. The work is a valuable addition to the lighter legendary lore of Hawaii.

CERAMICS AND MINERALOGY IN JAPAN.—Examples of the thoroughness with which Japanese scholars bring the most modern developments of research to bear upon economic problems, and at the same time welcome economic problems as enlarging scientific knowledge, are to be found in Vol. 1, No. 3 of the third series of Science Reports of the Tōhoku Imperial University. The outcome in this case is that mineralogists will learn much from experiments undertaken for the ceramic industry, since the scientific results that are obtained in the course of the investigations are recorded as matters of fundamental interest. Shinjo Satoh, for example, in his work on fire-clays, observes (p. 200) that kaolinite loses its combined water between 400° and 600° C.; that an internal change takes place between 900° and 1000° C.; and that between 1200° and 1300° C. a further internal change occurs from the recombination of free silica and aluminium silicate that became dissociated at a lower temperature. The gradual corrosion and ultimate fusion of quartz grains in a magma formed from lead glass and clay pulverised together is, among many other instructive matters, illustrated by microscopic sections (p. 195 and Pl. 11). Kunikatso Seto (p. 219) gives a number of new analyses of felspars, mostly from classical localities, and S. Kōzu and M. Suzuki (p. 233), following Des Cloizeaux, have studied the influence of temperature on the optic axial angle of sanidine. The locality and chemical composition of the specimens are, we think, not stated. The considerable increase in the optic axial angle recorded for high temperatures by Des Cloizeaux is found to be due to an abrupt change at about 900° C. X-rays have been utilised, and the Laue diagrams obtained show that this change is not accompanied by alteration of the space-lattice.

PHYSIOLOGICAL CLASSIFICATION OF OATS.—Investigations relative to the yielding and other properties of oat varieties under different conditions of soil and climate are described by M. G. Jones in Bull. C. No. 3, of the Welsh Plant Breeding Station. Trials were carried out with autumn and spring sown varieties from 1920–2, aspects of their economic and agricultural behaviour being considered. The different varieties are compared with one another in detail, with special regard to such points as the relation between the yield of straw and various other factors, for example, the time taken to reach maturity, the date of emergence of the panicle, average height of the plants and the yield of grain. The tillering capacity of the same varieties in different years was also considered. The information gained from the experiments indicates the possibility eventually of classifying varieties of oats on a physiological basis in such a way as to afford practical guidance to the farmer in the selection of his seed corn.

EFFECTS OF RADIUM RADIATIONS ON TISSUES.—The July issue of the quarterly journal *Radium* contains a number of papers dealing with the effects of the radiations from radium upon the tissues. These papers have for the most part been published in American Medical Journals and indicate the extent to which radium is used in many conditions other than malignant disease. A paper by Bailey and Bagg deals with the effects of irradiation on foetal development in the lower animals. On the basis of this work, they consider that if radiation is applied in late pregnancy, though it may not produce gross abnormalities at birth, it may hinder the growth and development of the child in later life. MacNeal and Willis describe a case of squamous-cell carcinoma forming on the hand of a radiologist after too frequent exposures to tubes of radium which he handled during the course of clinical work. A new device for the application of radium to the tonsils is described by Stewart, a previous article in this issue upon the treatment of neoplasms of the tonsil by Quick showing that good results are obtained by methods which ensure a thorough irradiation of the affected parts.

CRETACEOUS OVERFOLDING IN THE ALPINE REGION.—A detailed review of the results of recent observations on the Alpine overfolds, and particularly of L. Kober's work on the deeply penetrating "Tauernfenster" in 1921, is given by A. Tornquist of Graz in the *Geologische Rundschau*, vol. 14, pp. 110-145 (1923). The title, "Intrakretazische und alttertiäre Tektonik der östlichen Zentralalpen," shows how the movements that have produced successive overfolded sheets have been traced back into the Cretaceous period, the most striking evidence being the unconformable deposition of the Gosau beds upon the earliest overfolded series. The notice of Kober's "Bau und Entstehung der Alpen" in NATURE, vol. 112, p. 322, gave some hint of these conclusions.

METEOROLOGY IN THE EAST INDIAN SEAS.—The Meteorological Chart of the East Indian Seas for September, recently issued by the Meteorological Office, is of considerable interest. Winds and ocean currents are dealt with in detail, together with the normal atmospheric pressure and temperature of air and sea, as well as other matter of importance to the navigator. The chart comprises the Red Sea and covers the area from the Cape of Good Hope to the China Sea and Western Australia. It is well shown how under normal conditions the ocean current responds to the prevailing wind. The winds are under the direct influence of the several areas of high and low barometer, and in any position on the chart the seaman can interpret the changes he is experiencing, in normal circumstances, and can estimate how soon he may expect a change of conditions. The observations used extend over a period of about sixty years. On the back of the chart ocean currents are discussed for the track between Honolulu and Fiji. Current-roses are used on a system analogous to the wind-roses on the face of the chart, a system somewhat open to question, and for any extended alteration in this direction expert knowledge is desirable, if possible equal to that given to the general system, hitherto used, of showing ocean currents. A comparison is given of temperature in fixed and in portable screens on board ship. Probably the position of the screen must be left chiefly to the commander of a ship, with cautious suggestions. The usual form of screen used at sea, supposing the single louvre screen to be still in use, has to be screened itself, as single louvres are not effective.

RADIOACTIVITY AND SOLAR RADIATIONS.—It has been asserted that radioactivity is independent of all known physical agents; but M. A. Nodon, in the *Comptes rendus* of the Paris Academy of Sciences of June 11, describes additional experiments, which seem to confirm his previously expressed view that the process is greatly accelerated by very penetrating radiations from the sun. These radiations are able to penetrate a thin sheet of lead, the absorption being greater the higher the atomic number of the screen employed. The action is more marked during periods of solar activity.

TEMPERATURE OF THE CROOKES DARK SPACE IN GLOW DISCHARGE.—Observations on the glow discharge have recently been made in the Physikalisch-Technischen Reichsanstalt at Charlottenburg by Herr A. Günther-Schulze. He measured the energy delivered to the cathode, and there converted into heat; and found the ratio that it bore to the total energy delivered to the cathode and the dark space; this amounted to 72 per cent. in argon at 1·83 mm. pressure, 39 per cent. in hydrogen at 2·37 mm., and as much as 73·4 per cent. in nitrogen at 3·53 mm. If the free path of the atoms corresponds to room temperature, or the dark space is cool, this ratio is about 20 per cent. The natural conclusion is that the dark space is heated by the collisions taking place in it between the positive ions and the gas molecules; and a calculation of the probable temperature, in the case of one of the experiments with nitrogen, leads to the figure 720° C. The electrical energy expended in the dark space appears to be sufficient to account for this rise of temperature. The length of free path at this temperature is such that a considerable proportion of the ions pass through the dark space without colliding with a molecule, and the number of average free paths between the boundary of the dark space and the cathode must be small. All this agrees with the fact that, when the velocity of canal-rays is measured, a marked proportion have the velocity corresponding to the total cathode fall. The free path of the electrons is four times as great as that of the positive ions, so that most of them cross the dark space without collision, and begin to produce ions when they reach the negative glow, the maximum number per electron being equal to cathode fall divided by ionisation voltage. It follows that the ratio of the electronic current to the ionic current in the dark space is about 1 : 10.

FREE PATH OF SLOW ELECTRONS IN MONATOMIC GASES.—Using an incandescent cathode, a cylindrical grid surrounding it, and a concentric cylindrical anode at a voltage very slightly higher than the grid, it is found that the form of the characteristic curve showing the relation between anode current and grid voltage is strongly influenced, in the case of argon, by the abnormally long free path of very slow electrons through this gas. Minkowski and Sponer in a paper dated March 27, published in the *Zeitschrift für Physik*, give the curves obtained with argon, krypton, xenon, neon, and helium. For the first three gases there is a sudden rise in the current curve at zero voltage, followed by a sudden drop; with neon and helium, there is a less marked sudden rise, followed by a more gradual rise; in all these cases, however, and also in the case of mercury vapour, the shape of the curve near zero volts is to be explained by the fact that the free path of slow electrons is abnormally long. In the case of the inert gases, certain sharp upward bends in the succeeding portions of the curves are interpreted as being due to the fact that the electrons have reached the velocity required either to excite the atoms or to ionise them; and, making the proper corrections, the voltages agree quite well with those which direct measurement shows are needed to produce these effects. When the electrons strike the atoms in inelastic collision their velocities are reduced, their free paths are increased, and, as a result, the current becomes greater. With argon, a number of these sudden jumps of current are observed, corresponding to two different excitation voltages, to the ionisation voltage and to twice one of the exciting voltages or the sum of the two; this implies that the velocity of the electrons, at one of the last-mentioned points, is such that it can collide with an atom exciting it, and retain sufficient energy to excite another atom.

Report of the British Broadcasting Committee.

THE Committee appointed by the Postmaster-General on April 24 last to consider the present position of broadcasting in Great Britain and make recommendations for the future, made its report to him on August 23; the document (Cmd. 1951, H.M. Stationery Office, price 9*d*. net) was issued to the public on October 1.

By the terms of reference, the Committee had to consider: (*a*) Broadcasting in all its aspects; (*b*) the contracts and licences which have been or may be granted; (*c*) the action which should be taken upon the determination of the existing licence of the Broadcasting Company; (*d*) uses to which broadcasting may be put; and (*e*) the restrictions which may need to be placed upon its user or development.

The Report, which is admirably drawn up, has been signed by all the members of the Committee; reservations are, however, made on a few points by three of them. There is every evidence that very careful consideration has been given by the Committee to the many matters associated with the present-day broadcasting problem; and certain important recommendations are made in its Report. The task of the Committee has been one of peculiar difficulty, owing to the existence of a licence from the Post Office to the British Broadcasting Company for the operation of a scheme which, while still having some eighteen months to run, has in certain respects broken down in practice. The Committee has wisely decided to disregard to a great extent this complication and has dealt with the situation practically as though the Government had a free hand.

In view of the possibility that all large communities may eventually demand this inexpensive service, and that Imperial and international broadcasting services may eventually be established, the Committee considers that "the control of such a potential power over public opinion and the life of the nation ought to remain with the State, and that the operation of so important a national service ought not to be allowed to become an unrestricted commercial monopoly." It is further pointed out that a technical reason for such control also exists: all wireless telegraphy and telephony has to be conducted within a limited group of "wave-lengths," and every new wireless station takes up a certain "waveband," which no other sending station within a certain radius should be permitted to use. These "wavebands" must, the Committee considers, be regarded as a valuable form of public property, and the right to use them for any particular purpose should be authorised only after careful consideration and in such a way that the public interest may at all times be fully safeguarded.

The Committee recognises that broadcasting is still in its infancy and that new applications of it are likely to arise from time to time in many directions. It is of opinion that, if conducted on proper and sound lines, broadcasting will be of great educative value, both directly and indirectly, and it has been much impressed with the widespread enthusiasm which broadcasting has aroused. The great interest in wireless telegraphy and telephony promoted by broadcasting in almost every class of society cannot but tend, the Committee foresees, to produce beneficial results, stimulating as it does experiment and research. "The listener," the Report says, "may perhaps become an experimenter; the experimenter may possibly become an inventor."

The Report deals briefly with the events which led to the appointment of the Committee and gives an outline of the present scheme, its merits and defects being set out. The Committee places on record the fact that the evidence placed before it "demonstrates that the British Broadcasting Company have shown enterprise and ability of a high order in carrying out their undertaking and have done much valuable pioneer work in the face of many difficulties." The Report also comments upon the objections which have been raised by certain manufacturers and dealers to the present scheme. The Committee expresses the following opinions thereon. It agrees with the view that it is wrong in principle to attempt to control the manufacture and importation of wireless apparatus by means of licences issued by the Postmaster-General. As regards the remaining objections, it agrees that the scheme gives the British Broadcasting Company unusual powers; the Committee, however, has had no proof that the Company has made any improper use of its position. The scheme for levying a contribution on apparatus from the manufacturers was, the Committee points out, imposed by the Government as a condition of the broadcasting licence which the manufacturers desired.

The first of the recommendations contained in the Report relates to a matter affecting the Controlling Authority. The Committee considers that the questions involved in broadcasting are so complex, and the decisions to be taken so various and require so much technical and other consideration, that a Standing Committee (unpaid) should be set up by Statute to assist the Postmaster-General in the administration—technical, operative and general—of broadcasting. It is recommended that this Committee, for which the name "Broadcasting Board" is suggested, should be composed of an independent chairman, preferably a specially qualified member of the House of Commons, nominated by the Postmaster-General, and twelve members—of these two should be specially qualified persons nominated by the Postmaster-General, and the remainder should be drawn from certain interests or bodies named in the Report. In connexion with this recommendation, the Committee thinks that broadcasting may eventually become "so great a national responsibility as to demand the creation of a small paid body of experts, to whom (always subject to the Postmaster-General) its control should be entrusted."

Sir Henry Norman, a member of the Committee, makes an important reservation in relation to the composition of the proposed Board. In his opinion "a heterogeneous Board of thirteen members, giving voluntary service, eleven of them not necessarily with special knowledge of the subject and possibly without technical knowledge at all, presided over by a member of the House of Commons, who would, of course, be chosen from the political party in power, and whose tenure of office would be subject to political exigencies, would be inefficient, would carry little authority, and its proceedings would therefore be for the most part futile." Sir Henry is in favour of the appointment of a highly-qualified and well-paid Broadcast Control Board, say, of three members; that is to say, he would prefer that immediate effect should be given to that part of the Committee's Report which recommends the creation at a future date of a small paid body of experts for the control of broadcasting.

The arguments for and against the operation of the broadcasting services by the State are set out in the Report. The Committee considers that the objections to State operation of the service outweigh the advantages; at the same time, it is of opinion that no licence issued by the Postmaster-General should preclude the Government from using its own wireless stations for the broadcasting of such information as may be deemed desirable, subject, of course, to the ordinary broadcast programmes being interfered with as little as possible. Mr. C. Trevelyan, a member of the Committee, expresses regret that his colleagues were unable to agree to the operation of broadcasting by the Post Office. He is of opinion that a situation may easily arise in which this may be the only satisfactory possibility and gives reasons for the views he holds.

In dealing with the means of securing widespread reception with the cheaper types of receiving sets, the Committee points out that most of the existing difficulties might be avoided or reduced by the provision of a considerable number of transmitting stations of lower power than those already existing. The possibility of employing relay stations and linking them up by Post Office telephone trunk lines to main centres is also touched upon. Developments in these directions depend upon certain technical factors, and the outlay for thus dealing with the whole country would be large, both as regards the wireless stations and the land lines. Such a scheme, the Committee points out, would enable great numbers of persons to use "crystal" receivers, and it is likely the revenue from licences would be correspondingly increased. So far as future developments are concerned, the Committee thinks that the greatest latitude should be left to the Controlling Authority, and is a matter in which it would be unwise for the Committee itself to attempt to define the policy which should be adopted. A recommendation is, however, made that the licence issued to the British Broadcasting Company, which has the requisite organisation and technical and other experience, should, subject to certain variations in its terms indicated in a later part of the Report, be continued.

The alternative methods of meeting the cost of broadcasting and the several considerations that come into play are comprehensively dealt with in the Report. Having considered the evidence placed before it on the subject, the Committee has come to the conclusion that, in order to cover the cost of running its eight stations and to pay a dividend on its capital at the rate of $7\frac{1}{2}$ per cent. per annum, the British Broadcasting Company requires a revenue of 160,000*l.* a year—or, if allowance is to be made for future developments and improvements, not less than 250,000*l.* a year. Of the methods of raising revenue proposed, the Committee entirely rejects the one containing a proposal that the cost of broadcasting should be met wholly or partially out of public funds. With regard to the suggestion made to it that a substantial contribution towards the cost of the service should be obtained by means of a system of licensing the manufacture and sale of wireless apparatus, the Committee says that the proposal merits careful consideration, but it is unable to recommend its adoption.

In dealing with the existing method of raising revenue by means of fees collected on licences issued to owners of receiving apparatus, the Committee has had to consider the objection which has been raised in principle to a Government Department handing over public revenue collected by it to a private individual.

The Committee is of opinion that the arguments advanced against the adoption of this method of providing funds for broadcasting are based on an incorrect conception of the nature of the transaction and recommends the continuance of the present arrangement whereby revenue is collected by means of licences for receiving sets, a part of which is handed over to the British Broadcasting Company. The aim of the Post Office should, the Committee thinks, be to obtain sufficient revenue from licence fees (*a*) to cover administrative expenses in connexion therewith with a safe margin, and (*b*) to provide the necessary contribution to the cost of the broadcast programme. In the event of a considerable increase in the number of licences, the resulting surplus should, it is suggested, be devoted (i.) to reducing the licence fee; or (ii.) to improve the service; or (iii.) to both these purposes. As the Post Office authorities estimate that the cost in connexion with the issue of licences is unlikely to exceed 2*s.* 6*d.* per year per licence, an amount of 7*s.* 6*d.* per licence would be available, if required, to meet the cost of all broadcasting services. The total number of licences issued up to the present is about 170,000, and there are about 30,000 applications for experimental licences held in suspense, making a total of about 200,000. It is impossible, of course, to say what is the number of unlicensed stations; it is stated in the Report that the number is probably nearer 200,000 than 100,000. The Committee is of opinion that, if a high standard of programmes is maintained, it is not unlikely that within a few years the number of broadcast listeners may rise to a million or more. In view of the possibility of a very considerable increase in the number of licences, the Committee suggests that under any new arrangement a sliding scale should be adopted in relation to the proportion of the licence fees to be paid to the operating company or companies.

The Committee recommends that the marking of apparatus should be abandoned and one uniform licence introduced for broadcast reception and another for experimental work. It is further recommended that the broadcast licence should be placed on sale at Post Offices and issued on payment of the fee without any formalities or questions. It is pointed out that the Post Office would thereby be relieved of the difficult and somewhat invidious duty of determining whether applicants are genuine experimenters or not. With a view, however, of safeguarding neighbouring installations from interference, it is recommended that a clause should be inserted in the new licence in the following terms:—"The station shall not be used in such a manner as to cause interference with the working of other stations. In particular, back-coupling must not be used to such an extent as to energise any neighbouring aerial." Disregard of this condition should, it is suggested, render a licence liable to summary cancellation, and, further, that provision should be made for levying a penalty in cases where a licensee can be proved to have repeatedly caused serious interference. It is also suggested that for purposes of meeting cases where persons set up and use unlicensed receiving stations, statutory powers should be obtained similar to those already possessed by the Customs and Excise Department in connexion with the licences they control, so as to place the Postmaster-General in a position (*a*) to call upon suspected persons to fill in a form of declaration showing whether they are liable to a licence fee or not; and (*b*) to accept a compromise fine in the case of a minor default as an alternative to prosecution.

Having regard to the existing agreement between the Post Office and the British Broadcasting Company, the Committee recognises that it would not be possible for the Postmaster-General to introduce any change in the present scheme whereby the rights of the Company would be adversely affected, except as a matter of negotiation between the parties thereto. It is of opinion that the immediate adoption of its recommendations as a whole would entail certain adverse effects on the British Broadcasting Company and its constituent members. In consequence, the Committee suggests that if its recommendations are carried out forthwith, the proportion of the licence fee to be paid to the Company should be increased from 5*s.* to 7*s.* 6*d.* per licence, subject to the application of the sliding scale already referred to; this 7*s.* 6*d.* rate to take effect from November 1, 1922, when broadcast receiving licences were introduced. It is further recommended that the period of the Company's revised licence should be extended for two years beyond the original term, *i.e.* to January 1, 1927. It is proposed that in return for these concessions the Company, on its part, shall agree (*a*) to the immediate application of the scheme recommended; (*b*) to the revision of its articles of association, in order to provide (1) for dealers and retailers of wireless apparatus to obtain at least one 1*l.* share in the Company, (2) for members of the public to take up shares, if and when fresh issue of capital is made, and (3) for securing adequate representation on the Board by the new membership; and (*c*) to the abolition of the deposit of 50*l.* now required from members.

Mr. J. C. W. Reith (the General Manager of the British Broadcasting Company), a member of the Committee, makes a reservation as to the conditions proposed in relation to the issue of uniform licences and as to the general application of the scheme recommended; he is of opinion that under the proposed scheme the interests of the British manufacturers will not be sufficiently safeguarded.

On the technical side, the Committee makes certain important recommendations as to wave-lengths and the hours during which broadcasting services may be provided. It considers that arrangements should be made for the greatest possible extension of the existing broadcast band of wave-lengths (350 to 425 metres), preferably by the allocation of a band from 300 to 500 metres, excluding 440 to 460 metres, and that all possible steps should be taken to protect the band allocated to broadcasting from interference by other services. The Committee further suggests that the present restrictions on the hours of broadcasting should be removed, so that additional broadcasting facilities might be provided. These changes, it is considered, can be readily introduced without detriment to the other interests which have to be considered.

In relation to the broadcasting programmes, the Committee states that the British Broadcasting Company has achieved a large measure of success in gauging the public taste and providing programmes, and suggests that there should be a gradual extension of broadcasting of news, under proper safeguards; it is also urged that more latitude should be given to the broadcasting of special events without regard to hours. Finally, the Committee places on record its conviction that the Postmaster-General should remain the final arbiter when any question is raised as to what kind of matter may or may not be broadcasted.

Contemporaneously with the issue to the public of the Report of the Broadcasting Committee, a statement was sent to the Press by the Post Office; therein it is announced that the Postmaster-General feels that it is not possible for the scheme recommended by the Committee to be brought fully into operation immediately, but, with the view of the continuance of the broadcasting services, he has agreed with the Company to the introduction of a constructor's licence at a fee of 15*s.* for a limited period—the licensee must in such cases give an undertaking that, in constructing his apparatus, he will not knowingly use parts manufactured elsewhere than in Great Britain or Northern Ireland. Further, with the view of meeting the case of the 200,000 persons who are supposed to be in possession of unlicensed receiving apparatus, it is proposed to issue a special interim licence at a fee of 15*s.* also, covering present apparatus, whether home-made or purchased and irrespective of its place of manufacture, provided that this licence is taken out before October 15. In such cases no charge will be made for past usage, nor will proceedings be instituted for the failure to comply with the law. The issue of the constructor's and the interim licences will be continued until December 31, 1924, and, subject to sanction by the House of Commons, the Postmaster-General agrees to pay 12*s.* 6*d.* and 7*s.* 6*d.* out of the 15*s.* and 10*s.* broadcasting licences respectively to the British Broadcasting Company. The decision of the Postmaster-General to raise the licence fee to the home-constructor has come as a real disappointment to a very large number of them: to many of this class of listener the increase of the fee from 10*s.* to 15*s.* makes all the difference whether they can possess a licensed station of their own or do without one altogether.

An agreement has also been come to between the Post Office and the British Broadcasting Company for the modification of the articles of association of the Company on the lines recommended by the Committee. The licence now held by the Company will be prolonged, on suitable conditions, to the end of 1926; provided that the Company gives a satisfactory service and is willing to erect additional stations, should the Postmaster-General require this to be done, it is given what is virtually a monopoly during the unexpired period of the original agreement. However, the rights of the Postmaster-General are reserved, in certain circumstances, from and after December 31, 1924; thereafter not only may he, in appropriate cases, license other organisations, but he may also give them an adequate share of the revenue arising from new licences. The Postmaster-General may further (without regard to geographical area) license other services without withdrawing any part of the licence fees to which the Company may be entitled.

It is announced also that the Postmaster-General proposes at an early date to appoint an Advisory Board, as recommended by the Committee, to assist him in all important questions relating to broadcasting. Presumably this Board will be a statutory body: whatever may be the sources from which its membership is drawn, it is to be hoped that every care will be taken to avoid the creation of the inefficient type of Board so strongly condemned, and justly so, by Sir Henry Norman in the special paragraph contributed to the Report by him.

The action taken by the Postmaster-General on the Report of the Broadcasting Committee brings to a close the deadlock which has now for some months existed between the Post Office and the British Broadcasting Company. It is somewhat unfortunate that the restoration of peace between the parties to the original agreement has been purchased at the expense of a class, the home-constructors, who are deserving of greater consideration than they are about to receive. It is not at all improbable that the course of events may cause both the Postmaster-General and the British Broadcasting Company to regret that the recommendations of the Broadcasting Committee in relation to the introduction of one uniform broadcast licence have not been at once put into force.

Pioneers of Metallurgy.[1]

THE relationship of scientifically trained experts to the actual work of the world is much closer than at first sight would appear. The introduction of bronze and iron into the daily life of our ancestors marked the initiation of epochs of an importance to civilisation only secondary to the advent of fire. Metals were prepared from their ores, and worked into beautiful and useful forms, thousands of years before science, as now understood, existed. So far as we know, the necessary knowledge and skill must have been arrived at by a process of trial and error; or, in other words, by the method of experiment and observation. There have been, from time to time, revivals during which the arts and crafts made great steps forward. These steps must necessarily have resulted from the revival in individual workers of the dormant interest and belief in experiment and observation, no doubt stimulated by the generally increased activity of thought in the times in which they lived. The material progress of the past has invariably been due to observation of the actual phenomena leading to experiment on, and observation of, the effect of changed conditions on these phenomena; observation followed by thought, leading to experiment, followed in turn by further thought.

While the vast majority of our fellow-men have had neither the desire nor the capacity for experiment and observation, it is impossible to avoid the conclusion that there have been from the start of the human race individuals of this type to whom civilisation on its material side has owed practically everything. Of the equally important element of thought which must follow observations if these are to lead to practical achievements much might be said. While thought must be critical in the broadest sense, it must also be constructive. In the true pioneer it must, if need be, override the purely negative function of criticism, for without courage and enthusiasm in facing the unknown no real pioneering work can be done. This type of constructive thought in its higher development is one of the rarest of intellectual qualities.

The pioneers among the early workers in metals must, like their more modern successors, have possessed some strains of this great quality, this instinct which makes for progress. Here also we find that there has been absolute continuity in the evolution of workers in metals from our prehistoric ancestors down to the designers of this laboratory, which in itself is a visible expression of the latest thought and practice in the production and manipulation of metals. One of the laboratories here is named after Henry Cort, in memory of his epoch-making work on the manufacture of malleable iron in Great Britain one hundred and forty years ago. This may be gladly accepted as an admirable illustration of the point that the qualities which make for progress are deep down in the very nature of the individual pioneer, who, in many cases, owes little or nothing to the systematic knowledge of science. In Cort's case he knew the primary object of the free exposure of molten cast-iron rich in carbon to a moderately oxidising atmosphere in which the carbon was burned away, but it is improbable that he had any theoretical idea as to how the fibrous texture of the resulting iron was produced. By trial and error he definitely ascertained the conditions of atmosphere, of temperature, and of working at each stage which would attain the desired result, and this knowledge he was able to translate into a workable process on a large manufacturing scale.

While an exact knowledge of scientific laws and methods is a tool which must be placed in the hands of the future workers in, and directors of, the metal industries, the material on which this tool is to be employed must be their own close and personal observation of facts and phenomena, and time must be unsparingly devoted to the acquirement of this habit until it becomes instinctive and automatic. Let us not forget that, in spite of our wide knowledge of scientific laws and phenomena, the skilled craftsman may still be our model in this type of observation.

[1] Abstract of an address delivered by Sir George Beilby on September 11 at the opening of the new Metallurgical Department of the University of Manchester.

American Genetical and Botanical Research.

THE great amount of valuable research being accomplished in biology, genetics, and botany by the investigators of the Carnegie Institution of Washington is shown by the reports from the Departments of Genetics and Botany in the Year-Book for 1922 of the Institution. Reports are included not only of the experimental work at the Station for Experimental Evolution near New York, the Desert Botanical Laboratory at Tucson, Arizona, and the Coastal Laboratory at Carmel, California, but also from men holding chairs in various American universities, and from travel experiments in regions so far afield as South Africa and Australia. Only a few of the many lines of research of which this Year-Book contains reports of progress can even be mentioned in a short review.

We may mention Prof. W. E. Castle's continued studies on inheritance in mice, rats, and rabbits, in which the linkage relations between groups of characters are being worked out on a basis similar to the Drosophila experiments; and the further investigations of Prof. T. H. Morgan and his collaborators on the constitution of the germ-plasm in that little fly. Prof. C. A. Kofoid reports the discovery of amœbæ in connexion with such diseases as arthritis deformans (in bone marrow) and Hodgkin's disease (in lymph glands), and has also investigated various intestinal parasites. Mr. Albert Mann continues a monographic study of North American diatoms.

The work under the direction of Dr. C. B. Davenport includes many diverse fields of activity in genetics, eugenics, and animal behaviour. Co-operative breeding with mice and dogs; the study by Dr. Banta of intersexes and eyeless variations in parthenogenetic Cladocera; the continued experiments of Dr. Riddle on the metabolism of sex and other problems in pigeons; the investigations of Messrs. Blakeslee, Belling, and others on variations and chromosome relations in Datura, some of which parallel conditions discovered in Œnothera a decade ago; pedigrees of aristogenic and cacogenic families —these are but a few of the activities of this laboratory.

In botany, the report of Dr. D. T. MacDougal from the Desert and Coastal Laboratories is mainly concerned with physiological and ecological problems. The continued investigations of Dr. H. A. Spoehr and others on photosynthesis and other processes in the leaf have established a quantitative relation between photosynthesis and respiration. Dr. MacDougal continues the study of various problems of hydration and permeability in the plant cell, including the use of a type of artificial cell. The dendrograph is also applied further in the study of the growth of trees and minute changes in the volume of the trunk.

The ecological work includes a study by Dr. Forrest Shreve of the factors influencing the altitudinal distribution of vegetation in Arizona, various observations by Dr. W. S. Cooper on the strand vegetation of the Californian coast, and on the endemic conifers of the Monterey peninsula. Dr. W. A. Cannon reports an atmometer experiment to test the evaporating power of the air in the Karroo and other parts of South Africa, and a study of the transpiring power of various Karroo plants, including species of Aloe, Gasteria, Cotyledon, and Protea. A similar series of observations on Welwitschia near Swakopmund shows that its transpiring power is very low. Full reports of many of these lines of research are either in preparation or will be published later. R. R. G.

The Mechanics of a Cyclone.[1]

A NOTEWORTHY attack is made by Dr. V. H. Ryd, in the paper referred to below, on the problem of the circulation of the air in a cyclone, the source of the energy necessary for its maintenance, and the disposal of the rising air. The cyclone considered is necessarily "ideal," with circular isobars, the pressure at any distance from the centre being determined by an arbitrary formula which gives good results for the body of the cyclone but causes a discontinuity at the boundary.

The first part of the paper, entitled "Preliminaries," leads to a series of fundamental differential equations which cannot be integrated, and in the second part a graphical method of solution is developed, by which the air-paths appropriate to the pressure distribution are constructed. This method is next applied to the more important case in which a uniform pressure gradient is superposed on the original circular isobars. The results are shown both as actual paths of air particles and as a synchronous representation of actual wind such as we see in a daily weather chart. In both cases the presentation appears to be in good agreement with Nature. From the air-paths so constructed it is easy to compute the variation of the surface area occupied by any given mass of air, and consequently the regions of rising and falling air. This is done for the surface, in Fig. 33, which is reproduced here (Fig. 1). The figures represent the percentage value by which the area changes in an hour, the broken lines referring to contractions (*i.e.* rising air), and the full lines to dilatations. The region of falling air in the north-west quadrant is of great interest and receives an important verification, with which the author was apparently not acquainted, in a chart showing the distribution of weather with reference to the centre of a depression which crossed England in November 1915 (A. E. M. Geddes in Q.J.R. Meteor. Soc., 43, 1917, p. 15).

The third part of the paper applies the results so obtained to the construction of a picture of the mechanism of travelling cyclones, supported by an actual numerical example. The ordinary temperature distribution results at great heights in a system of open, nearly parallel isobars corresponding with winds of great velocity at the cirrus level; this is termed the stationary system, and from the nature of its origin it extends with decreasing intensity nearly to ground level. Hence a travelling cyclone can be divided into four parts, namely, the ground stratum; the lower stratum of the free atmosphere in which the velocity of the wind arising from the stationary system is less than the speed of the cyclone; the central part of the cyclone, in which these two are equal; and the higher stratum, in which the velocity of the wind from the stationary system is the greater. The resulting pressure distributions, wind velocities, and vertical motions in these layers are studied, and combined in a description of the circulation of the air.

The conclusion is that the air which is thrust up in the portion of the cyclone with negative coefficients cannot escape until it reaches the highest stratum referred to above; in this stratum it is carried forward out of the system. The same conclusion applies to the descending air, which is sucked from the higher stratum to the ground level. Hence the "stationary system" provides the energy of the cyclone, and the author considers that in most cases

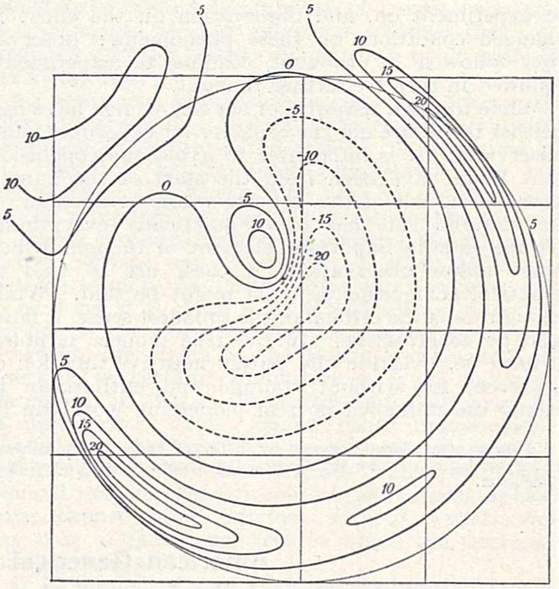


FIG. 1.—Variations of areas in a travelling depression.

the decay of an Atlantic cyclone is due to the dying out or disturbance of the stationary pressure field—a conclusion which requires further elucidation. In the last chapter attention is briefly directed to the agreement of these theoretical results with actual observations of the direction and speed of cyclones and the vertical and horizontal distribution of temperature, including the existence of a "cold front," which is thus shown to be a consequence, and not a cause, of the formation of a cyclone.

The paper is highly mathematical in treatment; this is, of course, necessary in a scientific account of new work, but it is unfortunate as being likely to deter the reader without a high mathematical equipment, although actually much of it can be read without mathematics. In view of the great interest at present taken in the "polar front" theory of cyclones and the importance of this vindication of the older view, it is to be hoped that the author will shortly present us with a more popular account, including more illustrations from Nature. It would have been better to have avoided attaching two different meanings to the symbol *R*, even though no confusion is caused thereby.

[1] Publikationer fra det Danske Meteorologiske Institut. Meddelelser Nr. 5: Meteorological Problems. 1: Travelling Cyclones. By V. H. Ryd. Pp. iv+124. (Kjøbenhavn: G. E. C. Gad, 1923.)

University and Educational Intelligence.

ABERDEEN.—The following assistants have been appointed: Anatomy, Mr. A. Lyall; forestry, Mr. E. V. Laing; mathematics, Mr. J. T. Lawrence; natural philosophy, Mr. H. D. Griffith; pathology, Mr. J. F. Davidson; physiology, Mr. J. Fiddes; surgery, Mr. W. Anderson.

CAMBRIDGE.—Of the additional annual grant of 30,000*l*. from the University Grants Committee, announced by the Vice-Chancellor in his annual address to the University, a sum of 4000*l*. annually from the total is ear-marked for the next ten years for the Women's Colleges.

ST. ANDREWS.—The induction of Prof. John Read to the chair of chemistry in the United College, and of Prof. Adam Patrick to the chair of medicine in the University, took place in the Hall of the University Library, St. Andrews, on Friday, October 5, at 4 P.M.

SPEAKING at a prize-distribution ceremony at the Maharajah of Kasimbazar's Polytechnic Institute, the new Vice-Chancellor of the University of Calcutta blessed Capt. Petavel's scheme (described in NATURE of August 26, 1922, p. 298) for establishing in Bengal co-operative educational colonies in which pupils would spend a considerable part of their time in remunerative employment on farms and in workshops. "Boys following the school and college courses as they are now, resemble," he remarked, "a flock of sheep rushing over a precipice,"—referring to the notorious overcrowding of the occupations for which alone those courses afford a suitable preparation. The scheme, however, notwithstanding its endorsement by the former Vice-Chancellor and many other Calcutta notables, still hangs fire, for want, apparently, of the funds necessary for making a start.

THE foundation stone of the first of the permanent buildings of the University of Western Australia was laid on September 1 by the Premier of the State, Sir James Mitchell. This building, which is being erected for the natural science lecture rooms and laboratories, is placed on rising ground overlooking Melville Water on the Swan River. The southern aspect of the building and its general design will give every facility for microscope work. It is proposed to proceed next with the transfer of the departments of chemistry, physics, and agriculture before removing the arts faculty and the administrative sections from the present temporary buildings in the centre of Perth city. The engineering school is already on the permanent site, having been in 1914 in the Crawley Mansion House on the transfer of the estate to the University by the Government of Western Australia.

PROGRESS in home economics education during the years 1920-22 is described in Bulletin No. 6 of 1923 of the United States Bureau of Education. A general demand for retrenchment in school expenditure led to proposals in many parts of the country for eliminating home economics as well as music, art, industrial arts, and agriculture from school curricula, but a reaction speedily ensued accompanied by a marked stimulation of local interest in the teaching of these subjects. Meanwhile, the campaign for economy had improved the teaching of such subjects as cookery through necessitating the use of simpler and less expensive methods and extreme care in regard to the quality of the resulting products. One of the most admirable modifications of home economics courses was the devotion of increased time and attention to training young women in child care and welfare. This training has been linked with the food courses in high schools through individual pupils being made responsible in the later stages of their work for the nutritional condition of some younger child. The food courses have themselves been markedly changed, cooking processes receiving less, and nutrition and dietetics greater emphasis than formerly.

RECENT awards of Industrial Bursaries and Overseas Science Research Scholarships by the Royal Commission for the Exhibition of 1851 are as follows. The names of the nominating institutions are in brackets. *Industrial Bursaries:* J. M. Todd (University of Edinburgh), W. McCartney (Heriot-Watt College, Edinburgh), G. B. Hamilton and D. Murray (University of Glasgow), G. G. Forrest (University of St. Andrews), T. Etheridge (University of Birmingham), A. G. Oates (University of Bristol), F. Allen (University of Leeds), W. B. Noddings and E. R. Knight (University of Liverpool), G. Lindley (University of Sheffield), F. F. Ridley (University of Durham: Armstrong College), J. S. Wilson (University College, Nottingham), J. F. Smith, J. M. Radcliffe, and W. A. P. Fisher (University of Cambridge), P. C. England (University of London: King's College), W. E. J. Budgen (University of London: East London College), A. Taffel (University of London: University College), G. A. Bonnyman (Imperial College of Science and Technology), J. R. Rowlands (University College of North Wales, Bangor), A. R. Brown (University College of South Wales and Monmouthshire, Cardiff), O. G. Evans (University College of Swansea), A. Goffey, R. E. L. Tricker, and C. R. Smith (University of Manchester). *Science Research Scholarships:* J. F. Lehmann, Physics (University of Alberta), I. R. McHaffie, Physical Chemistry (University of Manitoba), W. L. Webster, Physics (University of Toronto), R. W. E. B. Harman, Physical Chemistry (University of New Zealand), L. H. Martin, Physics (University of Melbourne), F. Lions, Organic Chemistry (University of Sydney).

Societies and Academies.

PARIS.

Academy of Sciences, September 17.—M. Joseph Boussinesq in the chair.—The president announced the death of M. J. Violle.—P. **Villard**: The true colour of clouds. It is generally admitted that the true colour of clouds is white, and that the colour effects observed are due to the coloured rays of the sun at sunrise and sunset. From the results of twenty years' observations the author believes that this is not always the case and that clouds may possess a colour of their own, not necessarily white, although illuminated with pure white light. Variations of colour have been noted during the disappearance and re-formation of light cumulus clouds.—P. **Sergesco**: The distribution of the characteristic values of the nuclei of Marty $N(x, y) = A(x)K(x, y)$.—Antoine **Zygmund**: The Riemann theory of trigonometrical series.—Georges J. **Rémoundos**: A property of elimination and algebroid functions.—O. M. **Tino**: The passage from the theory of the fundamental Fredholm functions to that of the fundamental Schmidt functions.—Serge **Bernstein**: The mathematical demonstration of Mendel's law of heredity.—A. **Petot**: A characteristic difference between the modes of action of front and back brakes. It is shown that there is a fundamental difference between the action of front and back braking on a motor-car. The latter arrests only the motion of translation of the car; in the former the brake also affects the car's movement of rotation round the vertical. —L. J. **Simon** and M. **Frèrejacque**: The action of dimethyl sulphate on salicylic acid, methyl salicylate, and methoxysalicylic acid. Sulphonation and methylation. In the absence of water, methyl sulphate and salicylic react, giving three substances, $C_6H_3(OH)(CO_2CH_3)SO_3H$, $C_6H_3(OH)(CO_2CH_3)SO_3CH_3$, and $C_6H_3(OCH_3)(CO_2CH_3)SO_3H$. The trimethyl sulphonated derivative is not produced.—Ch. **Courtot** and A. **Dondelinger**: Some new secondary bases of the indene series.—Paul **Dumanois**: A method of air-drying. A scheme for preventing the moisture in air reaching absolute alcohol or petrol stored in bulk. —F. **Vincens**: The aspergillomycosis of bees.—R. **Herpin**: Ethology and development of *Nereis caudata*.

SYDNEY.

Royal Society of New South Wales, August 1.—Mr. R. H. Cambage, president, in the chair.—S. **Dodd**: Cancer of the ear of sheep: a contribution to the knowledge of chronic irritation as a secondary factor in the causation of cancer in the lower animals. Cancer of the ear is rather common in sheep in Australia. Ears from 47 sheep so affected were examined microscopically: 32 were found to be definitely epitheliomatous; 9 showed a condition of chronic inflammation only, and 6 were in a precancerous stage. An affected sheep received alive was kept under observation; five months later the middle cervical gland showed signs of enlargement. Six months after receipt the sheep was killed and the autopsy showed practically the whole of the ear to be carcinomatous. The facts presented support the view that a chronic irritation, naturally occurring, may lead to cancer in the lower animals.—L. S. **Cash** and C. E. **Fawsitt**: The estimation of cineol in essential oils by the Cocking process. The method consists in mixing the oil with *o*-cresol in certain fixed proportions and finding the freezing point of the mixture. The method is more easily carried out than any of the other methods usually employed for estimating cineol. The results are at least as accurate as those obtained in other ways and the accuracy can be increased by taking into consideration the density of the oil.—H. J. **Hynes**: Investigations by the late C. O. Hamblin into the Helminthosporium disease of wheat. Pathogenicity tests indicated that the strain of Helminthosporium isolated from Marshall's No. 3 wheat at Cowra in November 1920 is a true parasite of the wheat plant, capable of causing a "Foot-Rot" condition and also lesions on the leaves. Seed from diseased plants when sown gave rise to healthy plants. The "Foot-Rot" condition was observed at Cowra in 1921 on 150 different wheat varieties. Spores of Helminthosporium were found on Slav rye, skinless barley, *Hordeum murinum*, *Bromus inermis*, *B. sterilis*, and spear grass.

Official Publications Received.

Mitteilungen der Naturforschenden Gesellschaft in Bern. Aus dem Jahre 1920. Pp. lx+179. Aus dem Jahre 1921. Pp. xlvi+320+12 Tafeln. Aus dem Jahre 1922. Pp. lxiv+171. (Bern: K. J. Wyss Erben.)

University of California Publications in American Archæology and Ethnology. Vol. 13, No. 9: A Study of Bows and Arrows. By Saxton T. Pope. Pp. 329-414+plates 45-64. (Berkeley: University of California Press.)

The North of Scotland College of Agriculture. Calendar, Session 1923-24. Pp. viii+128. (Aberdeen.)

The North of Scotland College of Agriculture: County Extension Department. Report on County Extension Work, 1922-23. Pp. 50. (Aberdeen.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-Verbaux des Réunions, Vol. 31: Rapport Atlantique 1922 (Travaux du Comité de Plateau Continental Atlantique) (Atlantic Slope Committee). Publié avec l'aide de Dr. Ed. Le Danois. Pp. 46+16 planches. (Copenhague: A. F. Høst et Fils.)

Smithsonian Miscellaneous Collections. Vol. 76, No. 2: History of Electric Light. By Henry Schroeder. (Publication 2717.) Pp. xiii+95. Vol. 76, No. 3: On the Fossil Crinoid Family Catillocrinidæ. By Frank Springer. (Publication 2718.) Pp. 41+5 plates. Vol. 76, No. 4: Report on Co-operative Educational and Research Work carried on by the Smithsonian Institution and its Branches. (Publication 2719.) Pp. 30. (Washington: Smithsonian Institution.)

Proceedings of the Aristotelian Society. New Series, Vol. 23: Containing the Papers read before the Society during the Forty-fourth Session, 1922-1923. Pp. ii+289. (London: Williams and Norgate.) 25s. net.

Diary of Societies.

MONDAY, OCTOBER 15.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. Shattock: Necrosis.

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—Extraordinary General Meeting.

TUESDAY, OCTOBER 16.

ROYAL SOCIETY OF MEDICINE, at 5.—General Meeting.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. G. Marshall: The Back Page of a Newspaper.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Prof. E. Newberry and others: Discussion on The Origin of Cultivated Plants.

WEDNESDAY, OCTOBER 17.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Discussion on a paper by Sir Napier Shaw and Capt. D. Brunt: Towards a Basis of Meteorological Theory—Thirty-nine Articles of Condition for the Middle Atmosphere.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—W. F. Charles: Peculiarities in the Development of the Ant's Foot.—M. T. Denne: A New Variable Light Screen for Use with the Microscope.—Prof. Ekendranath Ghosh: Monocystides from the Earthworms of Calcutta.

THURSDAY, OCTOBER 18.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Squadron Leader R. M. Hill: The Manœuvres of Inverted Flight.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. F. S. Boas: Some Aspects of the Departmental Report on English.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. A. Russell: Presidential Inaugural Address.

CHEMICAL SOCIETY, at 8.—R. G. W. Norrish: Studies of Electrovalency. Part III. The Catalytic Activation of Molecules and the Reaction of Ethylene and Bromine.

SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall), at 8.—Dr. Marie Stopes: Medical Contradictions and Mistakes in Evidence in her Recent Case (Presidential Address).

FRIDAY, OCTOBER 19.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Hernial Formations of Developmental Origin which occur along the Alimentary and Respiratory Tracts.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Sir John Dewrance: Presidential Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—A. Pereira: In a Kinema Studio.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—F. W. Dye: The Gas Boiler (or Circulator) and its Application.

PUBLIC LECTURES.

SATURDAY, OCTOBER 13.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Capt. W. H. Date: Wireless Telephony—a Popular Exposition.

UNIVERSITY COLLEGE, LONDON, at 5.—Miss I. C. Ward: The Application of Phonetics to the Curing of Speech Defects.

TUESDAY, OCTOBER 16.

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. A. V. Hill: The Present Tendencies and Future Compass of Physiological Science.

GRESHAM COLLEGE, at 6.—Sir Robert Armstrong-Jones: Physic. (Succeeding Lectures on October 17, 18, and 19.)

WEDNESDAY, OCTOBER 17.

UNIVERSITY COLLEGE, LONDON, at 3.—Prof. E. G. Gardner: Problems of the *Inferno* (Barlow Lectures). (Succeeding Lectures on October 24, 31; November 7, 14, and 21.)

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—A. Greenwood: Cancer and the British Empire Cancer Campaign.

KING'S COLLEGE, LONDON, at 5.30.—Prof. A. Dendy: The Biological Foundations of Society. (Succeeding Lectures on October 24, 31; November 7, 14, 21, 28; December 5 and 12.)

THURSDAY, OCTOBER 18.

KING'S COLLEGE, LONDON, at 5.30.—Prof. J. A. K. Thomson: The Function of Scholarship.

SATURDAY, OCTOBER 20.

HORNIMAN MUSEUM (Forest Hill), at 3.30—Miss M. A. Murray: Tutankhamen and his Times.