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A Folk Museum for England.

In a recent note in our columns (Nature, July 27, p. 155) it was stated that the Council of the Royal Anthropological Institute had appointed a committee, the object of which is to explore the position in regard to the institution of a folk museum in England. It may at first sight seem a little remarkable that England alone in the British Islands has no museum illustrative of the life, art, and industries of the people in the past which can be called national. Many of the provincial museums include valuable and sometimes quite extensive collections of local 'bygones'. Yet although some admirable schemes for a national folk museum have been formulated at one time and another, nothing comprehensive for the whole country and centrally situated has actually been attempted.

One difficulty upon which stress has been laid—a difficulty indeed which has been put forward as an explanation of the non-existence of such a museum—is that the material likely to be available is inadequate for anything in the nature of systematic treatment. In Wales, in Scotland, and in Ireland, it is argued, the remoteness of many areas from large centres of industry, their difficulty of access and the lack of communications, at any rate until the recent extension of motor traffic, have favoured the survival of primitive modes of life, of simple methods in industry, and of implements elsewhere obsolete; while in England rural industries and peasant life are both more standardised and more highly mechanised. To a degree this is necessarily true. Within the last twenty-five years, or more particularly since the War, many old-time household utensils and implements have fallen out of use and been thrown aside or vanished into the keeping of unknown private collectors. But many landowners and farmers with a feeling for the past still carefully preserve these relics of an earlier system of cultivation and a more simple mode of life which perhaps still prevailed in their own younger days. Nor does it necessarily follow that because a tool or implement is primitive that it is everywhere obsolete, even in areas which are not remote. Local conditions keep them alive. In Buckinghamshire, for example, the peculiar type of cottage lathe of the wood turner is still employed; in Essex the wooden plough is still in use as that best suited to the character of certain soils.

Recent experience shows that owners of the objects needed for a collection illustrative of the country life in the past are ready and willing to co-operate by loan, by gift, or by sale when once their

interest is aroused, and will assist in the search for objects to add to the collection among the country cottages in their district. If once a folk museum were instituted, there is abundant evidence that material would accrue rapidly and in plenty.

It must, however, be admitted that as time goes on the formation of such a national collection becomes increasingly difficult. Only the more durable objects will tend to survive, and as many of these are not in themselves beautiful, they will be cast aside as interest in them and knowledge of their uses grows less. Large objects such as ploughs, waggons, and carts will be broken up through difficulties of storage. More than twenty years ago, stress was laid upon this point in urging the need for a folk museum. The question of time is still more insistent to-day, and unless steps are taken within a little to preserve these evidences of the life of the past, it will be too late.

The correspondence now appearing in the daily press on the preservation of windmills, as well as the success of the Royal Society of Arts in its efforts to secure the preservation of typical villages and dwelling-houses of rural England, is an index to the interest which is taken by a part at least of the public in the culture of an earlier day. It only awaits direction to find expression in practical form.

It is indeed remarkable that while this interest in the culture of the past is manifested almost daily by the general public, we in England should lag behind other countries in a systematic effort to satisfy it. We have ample experience in other countries to guide us. Folk museums have been established at Stockholm, Oslo, Copenhagen, Helsingfors, Budapesth, Sarajevo, and elsewhere. It at least stands to the credit of the Soviet government that it has fostered the growth of local folk museums, and these, if the periodical reports are to be credited, are visited by thousands every year.

It is frequently, indeed it may be said it is usually, forgotten that anthropology is the study of *all* that man is and *all* that man does. It covers not only backward peoples, and the men of the remote past, but it should also take within its purview the civilised races. So far as physical anthropology—the study of man's bodily structures and his racial affinities as a member of the genus *Homo*—is concerned, this is generally recognised. It is less widely understood that study of the culture of civilised communities—a study as intensive as that now devoted to the backward peoples—is equally essential in the evaluation of 'modern' man. As a matter of practice and even of convenience, in the long run, this intensive study of 'modern' man must take the form of the history of development in culture, static at any given point of time, developmental over the whole series, and perhaps best, or at any rate most frequently exemplified in the study of survivals; but as the late Sir Lawrence Gomme saw clearly, it must be the study of survivals pursued in no spirit of mere antiquarianism. It must be the study of a living past in which the present is rooted.

It is clear that a museum which is to be at once an exposition and in a sense a laboratory of research in national culture must be something more than a mere collection in show cases of objects brought together because they are curious or obsolete. In 1911–12 a suggestion was made for the utilisation of the Crystal Palace and its grounds as a National Folk Museum. It was then suggested that the museum should serve for the display of developmental series of furniture, pottery, glass, iron-work, textiles, etc., and for collections illustrating the customs, distinctive beliefs, amusements, personal ornaments, inventions, etc., of the English peoples. This scheme was of a rather wider scope than a folk museum in the usual sense, for it was intended that it should include typical interiors, such as 'Chippendale' and 'Hepplewhite' and other period rooms; thus following the lines of some continental museums. A room was to be devoted to the apparatus and methods of producing fire in past times, a room for children's toys and games, a folk-lore room, and so on. The most important element in the scheme for the utilisation of the Crystal Palace was, however, the suggestion that ancient buildings from different parts of the country should be acquired and re-erected in the grounds. These were to be placed in such a way that no incongruous effect was produced by the close proximity of buildings out of keeping with one another, and they themselves were to be provided with furniture and appliances in accordance with their size and period.

In this proposal the scheme followed the plan of the open-air museum at Skansen, which is an offshoot of the Northern Museum at Stockholm. Here typical peasant houses from different provinces and of different dates have been gathered together, with characteristic furniture congruous in period and type. This museum has been in existence since 1891, and has proved not only a great and popular success, but also it has been of enormous value in preserving objects illustrating the peasant culture of the country. A similar museum has recently been opened in Holland. In some of the

continental folk museums the idea has been carried so far that the attendants wear the distinctive provincial peasants' dress.

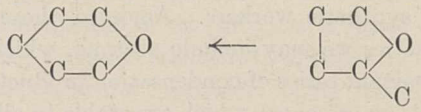
There can be no two opinions that an open-air museum of the type here suggested, illustrating the peasant art and culture of England from the earliest times for which material is available, would be of the greatest scientific and educational value; nor can there be any question that buildings of the type desired and of various periods can be obtained without any great difficulty. Nor would they be confined to dwelling-houses. Windmills, water-mills, tithe-barns, oast-houses and so forth should be included. The proposal would in no way conflict with the endeavours that are now being made to preserve peasant dwelling-houses and other buildings of historical and cultural interest. Every day, unfortunately, cottages are being pulled down which these efforts cannot save, whereas if it were possible that they could be re-erected as part of an open-air museum, they would be preserved in perpetuity. It must also be remembered that the number of buildings which could be accommodated in this way is strictly limited. Consideration of space alone would preclude indiscriminate removal of interesting buildings—an objection which has been made to the scheme. It would lead rather to the preservation of at least some of which the destruction was otherwise inevitable.

It is possible that the Royal Commission on the National Collections and Museums in its final report will touch upon the question of folk museums, although there is little hope that any suggestion of an extension of the English National Collections in this direction will be made in view of financial and other considerations. Two obvious difficulties stand in the way of any action. The first is that of a site. It is evident that for a museum of this kind to be utilised to the full and to obtain an adequate return for the expenditure of time and money necessary for its establishment, it must be situated in, or readily accessible from, London. Only so will it be utilised readily by the student or will it attract the general public. Yet unless its upkeep is financially a matter of national concern, it will have to depend upon admission fees for its income. This brings us to the second difficulty, that of finance. In view of the claims at present made upon the sums which are set aside for museum purposes, it is clear that for capital expenditure and also, in the early days, for expense of upkeep, the committee will have either to find a generous benefactor or arouse sufficient public interest to secure a liberal capital sum by subscription.

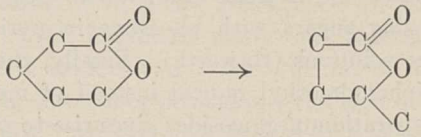
Chemistry of the Sugars.

The Constitution of Sugars. By Prof. W. N. Haworth. Pp. vii + 100 + 2 plates. (London: Edward Arnold and Co., 1929.) 8*s.* 6*d.* net.

THE most important development in the chemistry of the sugars since the classical researches of Emil Fischer is the discovery that the 5-atom ring system, which he assigned both to the sugars and to the lactones derived from them, is wrong as regards the sugars, although it is right as regards the lactones of the normal type. No clear explanation has yet been given to show why a six-atom ring should be more stable than a five-atom ring in the sugars,



whilst a five-atom ring is more stable than a six-atom ring in the lactones, where one of the carbon atoms is doubly bound to oxygen.



Nevertheless, this has now been established as a general proposition, which applies to the pentoses as well as to the hexoses and to the disaccharides as well as to the monosaccharides. Whilst, however, glucose in the natural glucosides is always found to be linked up as an α or β glucoside with a six-atom or pyranose ring, the isomeric fructose occurs in compounds such as sucrose as a five-atom or furanose ring derived from a labile γ-fructose, and it is mainly for this reason that the synthesis of cane-sugar has been so long delayed.

Emil Fischer's work was based on his discovery of the use of phenylhydrazine to give sparingly soluble crystalline derivatives from which the sugars could be recovered after they had been isolated as hydrazones or osazones. In the same way, the new work on ring-formation depends on the use of methylating agents, namely, methyl iodide and silver oxide (Purdie and Irvine, 1903) or methyl sulphate and aqueous alkali (Haworth, 1915). With the help of these agents every unused hydroxyl-group in a sugar (for example, five in glucose and eight in cane-sugar) can be turned into methoxyl, and as it were anæsthetised whilst the remainder of the molecule is being operated upon. When the necessary surgical operations have been performed the sugar can sometimes be recovered or restored to life, but more usually the subsequent

proceedings take the form of a post-mortem examination, whereby the physiology of the living sugar is deduced from the anatomy of the methylated residues.

Drastic processes such as these have been needed to eliminate Fischer's fundamental error in identifying the ring systems of the sugars with those of the common lactones, but in the future more importance may attach to the use of milder anæsthetics, such as the process of acetylation whereby Pictet, in 1928, ' fixed ' fructose in its labile γ-form and then united it with glucose, which had been fixed in the stable pyranose form by a similar process of acetylation. Elimination of the acetyl-groups then produced the real cane-sugar, which had eluded all the earlier synthetic workers. Amongst these milder anæsthetics we may include acetone, which forms an important series of condensation products of the acetal type (Fischer), which are stable to alkali but unstable in the presence of acid. Carbonates, which are unstable to alkalis but more stable to acids than the acetone compounds, can also be condensing sugars with phosgene in pyridine or alkaline solutions (Haworth). Finally, the use of the triphenylmethyl radical instead of methyl in the preparation of glucosides gives rise to products in which the characteristic properties of an ether are changed towards those of a salt, so that the radical can be eliminated with exceptional ease, like a mild local anæsthetic, when it has served its purpose and is no longer needed.

The revolutionary changes which have taken place in the chemistry of the sugars during the past ten years have been effected almost entirely by Prof. Haworth and his colleagues, who have been untiring in the laborious work involved in methylating both the six-ring sugars and the five-ring lactones, and then preparing from the products the methylated forms of the unstable five-ring sugars and the six-ring lactones. In this way the somewhat tentative earlier efforts to bring the rotatory powers of the sugars into line with C. S. Hudson's lactone rule have ultimately been realised, and the new six-atom ring formulæ have been established beyond dispute for glucose, galactose, mannose, fructose, arabinose, xylose, lyxose, and rhamnose, all of which yield (with the exception of the natural fructosides) derivatives containing a six-atom ring.

The same method can be applied to the disaccharides and the polysaccharides, which yield methyl-derivatives, from the study of which it is possible to determine not only the size of their ring-systems, but also the points by which one ring is attached to another in the structure of the more complex compounds. In this way complete structures have been deduced for the *disaccharides*, maltose, cellobiose, and lactose, where two six-atom rings are linked through an atom of oxygen, sucrose, where a six-atom glucose ring is linked through oxygen to a five-atom fructose ring, gentiobiose and melibiose, where two six-atom rings are linked through an oxygen atom and a methylene group. In the *trisaccharides*, raffinose and gentianose, a six-atom galactose or glucose ring is linked through $-O.CH_2-$ to a six-atom glucose ring and then through oxygen to a five-atom fructose ring. Finally, the *polysaccharides*, starch and cellulose, which yield glucose on hydrolysis, have been shown to consist of six-atom glucose rings linked together through oxygen, whereas inulin, which is readily hydrolysed to fructose, contains a series of five-atom γ-fructose rings, linked through $-O.CH_2-$.

The introduction of the six-ring into the chemistry of the sugars leads to very interesting stereochemical considerations, since it involves the reappearance of the familiar hexagon, which plays so conspicuous a part in the structure of ice, of graphite, and of the diamond, as well as in the chemistry of aromatic compounds. Although these rings are usually linked together only in chains through $-O-$ or $-O-CH_2-$, it is possible to construct models in which the linking atoms and the atoms of the side chains as well as those of the ring are situated on a hexagonal lattice ; and the existence of such a lattice, as well as some of its dimensions, have now been established by X-ray analysis, especially of ramie fibres.

Prof. Haworth might have written a text-book on the chemistry of the sugars which would have included the pre-War work with which Emil Fischer's name is so largely associated, but this would obviously have been a time-robbing task for one who is fully occupied with original investigations on the subject. Such a book will perhaps be written when the stream of research from the Birmingham laboratory begins to flow less swiftly, and will then form a very welcome contribution to chemical literature ; but, in the meanwhile, the author has taken it for granted that his readers are familiar with the classical work on sugars and has given an authoritative review of the more recent developments, including not only work which has already been published, but also a large amount that is still in the press. The book is therefore not only up-to-date but actually in advance of current literature, and will be a standard work of reference until it becomes out-of-date, mainly as a result of the author's own further researches. T. M. L.

Desert Plants and Water.

(1) *The Plant in Relation to Water: A Study of the Physiological Basis of Drought Resistance.* By Prof. N. A. Maximov. Authorised English translation, edited, with Notes, by Prof. R. H. Yapp. Pp. 451. (London: George Allen and Unwin, Ltd., 1929.) 21*s*. net.

(2) *Die physikalische Komponente der pflanzlichen Transpiration.* Von A. Seybold. (Monographien aus dem Gesamtgebiet der wissenschaftlichen Botanik, Band 2.) Pp. x+214. (Berlin: Julius Springer, 1929.) 26 gold marks.

(3) *Der Wasserhaushalt ägyptischer Wüsten- und Salzpflanzen: vom Standpunkt einer experimentellen und vergleichenden Pflanzengeographie aus.* Von Dr. Otto Stocker. (Botanische Abhandlungen, herausgegeben von Prof. K. Goebel, Heft 13.) Pp. 200. (Jena: Gustav Fischer, 1928.) 12 gold marks.

THE recent appearance of these three monographs is evidence of the very great interest now taken in the water relationships of desert plants, an interest which should be shared by those administratively responsible for arid areas under British control, for the researches summarised in these pages are closely connected with a very important economic problem, that of making the desert "blossom like the rose".

As is apparent from the titles, two of these monographs treat the subject from a more general point of view, and British investigators will think it particularly fitting that the late Prof. R. H. Yapp lived long enough to complete his task of editing this translation of Prof. Maximow's book. Prof. F. E. Weiss contributes a brief biography of the editor, whose footnotes show the deep interest he took in this, his last, completed scientific task; at the same time they bear striking witness to his great fitness for this task and have added very greatly to the value of the book.

The plant of the dry habitat is, by definition, a xerophyte; it has often been assumed to be also xeromorphic, that is, so built that it conserves its water supplies better than does the plant of the normal habitat, the mesophyte. This assumption had little experimental basis and has been challenged with great force and originality by Prof. Maximow, who has had wide experience of the desert regions of south-eastern Europe and of Asia. His criticisms and suggestions have aroused great interest, but many of his earlier writings are very inaccessible outside Russia, and English readers will be very glad to have this translation, which is evidently, in effect, a new book, to which Prof. Maximow has added new sections, whilst Prof. R. H. Yapp added numerous critical and complementary footnotes.

Prof. Maximow has suggested that the primary qualification of the true desert xerophyte is its capacity to survive very considerable water loss. In spite of its 'xeromorphic' appearance and structure, such a plant often loses water freely so long as it is readily available, but when its water content is so diminished in arid conditions that its evaporation is perforce low, it still clings stubbornly to life. The great value of Prof. Maximow's book, however, lies in the wide perspective in which this special problem is regarded. There is a full and critical treatment of the subjects of water absorption, root pressure, transpiration, stomatal control, etc., experimental methods being briefly, but critically, passed in review as well as the general position of our knowledge of these subjects. The book is clearly a 'progress report' on a subject where advance in recent years has been relatively rapid. Prof. Maximow points out that stomatal control is evidently not the only factor at work reducing water loss throughout the afternoon of a sunny day. He gives his reasons for not accepting the 'incipient drying' of the walls as the alternative method of control, and promises a new analysis of the subject, in which it is evident that importance will attach to the water content of the subaerial regions of the plant, as the result of the activities of the root, etc. Evidently we may expect new contributions with fresh experimental data from the Institute of Applied Botany at Leningrad at no distant date.

One particularly valuable feature of this summary of the present position is its full treatment of a mass of original and suggestive Russian work which is very little known in the rest of Europe and in America. In particular, one may cite the full account of the work of Zalenski upon the anatomical differences between leaves at different heights upon the stem, which preceded most modern work upon sun and shade leaves, and of the anatomical studies made by Kolkunov upon the anatomical characteristics of drought resistant plants. To this anatomical section Prof. Yapp contributes some very interesting and lengthy notes based upon work by Yapp and Mason upon the relation of water content to leaf structure, which is as yet unpublished.

(2) Seybold's monograph contains a very temperate criticism of the old teleological point of view as to xeromorphy, but then shows that in

some respects the desert plant may actually be so constructed as to cut down evaporation. The physical problems raised by evaporation from plants are discussed. It is pointed out that the leaf is really a special case of a wet-bulb hygrometer and that leaf temperatures give a definite indication of the progress of evaporation if the method is used under suitable conditions. Many new data are thus obtained as to evaporation from leaves, and it is shown that experiment supports a conclusion reached on physical grounds that the rate of loss of water vapour through the stomata is scarcely affected by wind movement, the diffusion shells determining the rate being within the stoma. In the desert plant, with its thick cuticle, all evaporation is through the stomata and the rate of water loss does not alter in a wind. In the plant of the wet habitat, with thin cuticle, much water is lost through the cuticle; in this case the rate of water loss goes up rapidly in a wind.

Certain structural features of the desert plant, therefore, would seem to deserve, in the light of Seybold's work, the descriptive label 'xeromorphic'; but Dr. Otto Stocker suggests (3) that this term should be dropped, as its implications may not be justified. He suggests that these characteristic structural features should be described as 'ericoid', 'succulent', etc., descriptive terms which do not necessarily imply adaptive values. Dr. Stocker noticed one characteristic of the root systems of the Egyptian desert plants that he studied which must be of great importance to them. He points out that the cells of these roots had osmotic pressures up to 40 and 50 atmospheres, quite as high as he had found in the roots of the plants growing in the physiologically dry habitat of the salt marsh, the characteristic 'halophytes'.

Research on Rheumatic Affections.

Annals of the Pickett-Thomson Research Laboratory. Vol. 4: *The Pathogenic Streptococci; an Historical Survey of their Rôle in Human and Animal Disease.* Part 1: Pp. vii + 250 + 7 plates. Part 2: Pp. viii + 251-494 + plates 8-18. (London: Baillière, Tindall and Cox; Baltimore, Md.: The Williams and Wilkins Co., 1928–1929.) 42*s.* net each Part.

THE six main monographs collected in this volume deal with the rôle of the streptococci in rheumatic fever, in chorea, in erythema nodosum, in carditis, in acute suppurative arthritis, and in chronic arthritis. These monographs give a more or less complete résumé of all the researches of value which have been carried out as to the relationship of the streptococci in the diseases under discussion, but they are not mere records of the experimental results. They contain a great deal of valuable literature on both the clinical and public health aspects—the blood changes in rheumatic fever, the association of tonsillitis with it, its prevalence and danger, its epidemiology and infectivity, etc. The clinical aspects of carditis and the various forms of chronic arthritis are discussed. The treatment of the various conditions by vaccines and sera, and the histological characters of the pathological lesions are carefully reviewed. In fact, the diseases dealt with are treated in an all-round fashion which it would be impossible to find in any other single publication.

The very fact that the bibliography contains more than 1600 references, and that these have been carefully read and the essential parts abstracted, is sufficient evidence of the amount of work involved in compiling these monographs. To the experimental worker on rheumatic affections, to the clinician and to the public health official interested in arthritic diseases, this very exhaustive review of the literature will be of the greatest value. The authors are not content to give the views of others, but in all the monographs there is a discussion of the findings and the conclusions of the authors themselves. This is by no means the least valuable part of the monographs.

Though we cannot agree with all the conclusions drawn by the authors, and though parts of the work will no doubt have to be altered in the light of further researches, yet we feel that this work is an extremely valuable contribution, and we must congratulate the authors on its production.

The photographs by which the volume is illustrated are extremely good, and in themselves form a valuable contribution. Many of these are of colonies grown on Warren Crowe's chocolate agar medium, but we think too much importance has been attached to the appearance of the colonies in an attempt at differentiation. The more one works at bacteriology the more uncertain one becomes of attaching too much importance to variation in shape, size, and general contour of colonies. There seems little doubt that we shall have to revise our classification, and especially our nomenclature, when we realise that one strain of an organism may present different forms of colonies on different media, and especially on complex media such as Crowe's chocolate agar.

It is gratifying to see in the article on "A Simple and Rapid Test for the Differentiation of Streptococci" by one of the authors, that he has the courage to state that fermentation tests are only of third-rate importance as a means of classification and identification. His test with Lugol's iodine is interesting, but we do not think sufficient evidence has been given to say that it will be of value in classification. The value of the test depends on the accuracy of Crowe's medium as a means of differentiating the types of streptococci, and we are not convinced of this accuracy. The medium, as we have already said, is complex, and the streptococci are organisms whose vitality outside the body is not high. In any colony, or any mass of these organisms, one will find actively growing members and dead members, with various stages between the active and the dead ones. It seems reasonable to assume that the action of the organism in these different stages may produce different chemical reactions, or the same chemical reactions in different stages of intensity, and that the colour reaction with the iodine may appear in different degrees of intensity, and that therefore an iodine positive and an iodine negative may be the same type of organism in different degrees of activity. We have learned a great deal from the work of Andrewes and Cowan about the rough and smooth forms of streptococci. We do not regard them as different types, and we see less reason to regard an organism which is iodine positive as a different type from one which is iodine negative.

We are surprised that the author of this test—even if the test proves to be reliable, and we hope it may prove so—should claim that by it Birkhaugs *Streptococcus Erysipelatis* has been identified with Crowe's Al(4) type. Though both are toxin producers, surely this and the iodine positive reaction are feeble evidence of identification. We regret that this test, of which the author states his experience has been a short one, should have been inserted. It may be valuable, but its value has yet to be proved, and we think it would have been wiser to have established the proof clearly before including it in a volume of this nature, which should be in every bacteriological laboratory as a book of reference.

The last monograph deals with Rosenow's hypothesis of elective localisation and its bearing on rheumatism, poliomyelitis, encephalitis lethargica, and dental infection. In the sections of this monograph, Rosenow's views that mutation in the characters of a given germ occurs in response to its environment are dealt with very fairly, and the criticism by the author—Dr. Warren Crowe—is very just. We think this monograph will prove of considerable interest, though we cannot say of great value, to those who are not familiar with Rosenow's work. Much as we disagree with Rosenow's conclusions, we think the authors have done well to include this review of his work, and some of the criticisms of that work.

J. M. BEATTIE.

International Genetics.

Verhandlungen des 5 Internationalen Kongresses für Vererbungswissenschaft, Berlin, 1927. Band I. Pp. viii + 784. Band 2. *Herausgegeben von Hans Nachtsheim.* (*Zeitschrift für induktive Abstammungs- und Vererbungslehre*, Supplementband 2.) Pp. viii + 785 - 1647 + Tafeln 8 - 14. (Leipzig: Gebrüder Borntraeger, 1928.) Bd. 1-2, 100 gold marks.

THE Fifth International Congress of Genetics was held in Berlin in September 1927, and its *Proceedings* have appeared with commendable promptness in two large volumes. The first gathering of this kind was held in London in 1899, before the name of Mendel was known. It was organised by the Royal Horticultural Society and was styled an "International Conference on Hybridization and Plant Breeding". When the next was held in New York in 1902, Mendelism was still too new to have much effect on the proceedings. In 1906 a third conference was held in London under the same auspices as the first, with Bateson as president, and on this occasion he introduced the term genetics for the study of heredity and variation. The fourth conference was held in Paris in 1911, and the fifth was to have taken place at Berlin in 1916. It was 1927 before this congress was finally held, and in the meantime genetics underwent immense developments, as evidenced in part by the contents of these volumes.

Genetics may be said to have transformed the face of modern biology. Its conceptions have permeated much of the best work of systematic botanists and zoologists, while forming the background of all the work in experimental evolution. Even palæontologists have found it necessary to grapple with and incorporate these conceptions in their work, as witness the investigations of Brinkmann on Ammonites, summarised in these *Proceedings*, and the writings of Bather in Great Britain. Only the physiologists have held aloof, despite the fact that Bateson's early reports to the Royal Society were called investigations in the physiology

of heredity, and that Jost's "Plant Physiology" (1907) contained a chapter summarising the contemporary knowledge of heredity and variation from a physiological point of view. Owing to recent developments in genetics the gene is being recognised not merely as a static entity but also as producing its effects dynamically in the ontogeny of the organism. Genetics is thus becoming more physiological, and it is to be expected that physiologists will ultimately recognise that reproduction —the core of genetics—is after all a physiological process.

The 150 papers presented before the Congress, with its six sections and nearly a thousand members, cover such a wide range, representing the many ramifications of modern genetics, that it is impossible here to indicate more than their general scope. The general topics discussed before the whole Congress included the problem of evolution and the modern theory of heredity, by Wettstein of Vienna; polyploidy and species formation, by Rosenberg of Stockholm; chromosome relations in hybrids, by Federley of Helsingfors; the geographic centres of cultivated plants, by Vavilov of Leningrad; genic modification, by Muller; mutable genes, by Demerec; the genetics of *Datura*, by Blakeslee; the organisation and function of an animal breeding research department, by Crew; and the future development of eugenics, by Ploetz. The classic genera *Œnothera* and *Drosophila* were well to the fore, ten Œnotherologists taking part in the conference and seven papers on *Drosophila* being presented. Numerous papers were concerned with cultivated plants, such as wheat, oats, rye, barley, maize, apples, plums, cherries, potatoes, beets, peas, and strawberries; also several on fowls, mice, rats, and one on the tortoiseshell cat.

A number of the papers were primarily cytological, such as that of Miss Blackburn on the chromosomes of *Silene*, Levitsky on *Festuca*, M. Navashin on *Crepis*, Sveshnikova on *Vicia*, Cleland and Gates on *Œnothera*, Tischler on *Ribes* hybrids, de Vilmorin on Solanaceæ, and Vandel on geographic parthenogenesis. Mathematical papers were contributed by Bernstein on the theory of crossing-over, Smirnov on variability, Weinberg on twins and on heredity.

A comparison of these *Proceedings* with those of 1911, when genetics was just getting into its stride, serves to emphasise the many directions which genetic work has taken and the bright possibilities which exist in every one of them for further development. R. R. G.

Our Bookshelf.

Grundzüge der theoretischen Logik. Von Prof. D. Hilbert und W. Ackermann. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen, mit besonderer Berücksichtigung der Anwendungsgebiete, herausgegeben von R. Courant, Band 27.) Pp. viii + 120. (Berlin: Julius Springer, 1928.) 7·60 gold marks.

THIS book on theoretical logic is based on the lectures of Hilbert and the work of Bernays and Ackermann. The first chapter summarises the calculus of propositions as deduced from a set of axioms, four of which are the same as those in Whitehead and Russell's "Principia Mathematica". The primitive proposition known as the associative principle was proved by Bernays in 1926 to be deducible from the other axioms and is not included. These axioms are shown to be complete, independent, and free from contradiction. While the fundamental symbols used denote the same ideas as those in the "Principia", the only symbol common to both systems is that for the logical sum, while the sign for equivalence of truth value is almost the same as the sign of negation in the "Principia". One feels inclined to protest against this unnecessary multiplication of notation, which is confusing. A work like the "Principia" should be considered as fixing a standard notation in theoretical logic. Moreover, a further sign (afterwards discarded) is introduced in the second paragraph for "equivalence of meaning"—at best a notion foreign to the calculus of propositions.

The second chapter introduces the propositional function of one variable, and in Chapter iii. the restricted calculus of propositional functions of several variables is discussed. This is likewise developed from a set of axioms due to Bernays, but here the proof of freedom from contradiction begins to encounter difficulties of a more fundamental nature. In the last chapter paradoxes are discussed and their solution by Russell's theory of types. The difficulties arising in the extended calculus are pointed out and suggestions made for avoiding them.

The book is a forerunner of a larger work promised by Hilbert and Bernays on the foundations of mathematics, to which it will prove an interesting introduction. The subject formed the topic of the inaugural lecture given by Hilbert at the Mathematical Congress at Bologna in 1928.

L. M. M.-T.

The Earth: its Origin, History, and Physical Constitution. By Dr. Harold Jeffreys. Second edition. Pp. ix + 346. (Cambridge: At the University Press, 1929.) 20*s*. net.

THE demand for a second edition of this work, after only five years, must give deserved pleasure to the author, and has enabled him to revise and extend it in various directions. The book is increased in length by 68 pages, with a proportionate increase (4*s*.) in price. The principal change concerns the part dealing with seismology; the first

edition (1924) omitted reference to much continental work on this subject, done in the years 1907–1916. Two chapters in place of one are now devoted to seismology, and they are placed earlier in the book.

In this and other sections the conclusions reached on many points are more definite than in the first edition; for example, the age of the earth, formerly estimated as between 1·3 and 8 billion (10^9) years is now limited between 1·3 and 3 billion years; the earth is stated to possess a central core, apparently liquid, with a radius rather more than half that of the earth as a whole, and with a sharp boundary; the bodily tide of the earth is stated to imply that the rigidity of this core is less absolutely than that of the outer shell, and not merely less in proportion to its density. The account of the earth's thermal history has been re-cast, and the discussion of isostasy has been clarified and rendered more precise.

The original appendix C, dealing with the relation of geophysics to geology and geologists, is also expanded, and is expressed in very plain terms; for example, the replies of a well-known geologist to certain criticisms by the author are stated to be "a series of evasions and irrelevancies". Many readers may think that controversies are better conducted in milder terms than these. In general, however, the author's clearness and directness of statement are to be welcomed; one may hesitate to believe that his conclusions are always so certain as his language seems to imply, but definiteness at least affords a stimulus and an opportunity to critics, and arouses discussions which often advance knowledge. There is no doubt, moreover, that the author's synthesis of diverse branches of geophysics has been of great service to the science.

Further editions of this valuable work will certainly be called for; it may be suggested that, in these, the author should extend to all the chapters his commendable practice, at present applied only to some of them, of giving a summary of the main arguments and conclusions in the chapter.

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 13, Teil 1: *Die Ionenleitung in Gasen*, von Prof. Dr. E. Schweidler; *Die elektrischen Eigenschaften der Flamme*, von Prof. Dr. A. Becker. Pp. viii+314. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 29.60 gold marks.

THIS volume deals with two aspects of the conduction of electricity to which comparatively little attention is being paid at the moment. In the first part of the book, Prof. Schweidler summarises concisely the main work which has been done on the general properties of ions produced in gases at relatively high pressures by external agents. The second part, by Prof. Becker, is upon thermally ionised systems. Both subjects still offer a wide field for research, and it is perhaps significant that the most recent measurement of the recombination coefficient (by Dr. Mohler) has been made by a combined electrical and optical investigation in an ionised system at *low* pressure, whilst at the same time the conceptions of mobility and diffusion, which have been developed in connexion with essentially high-pressure phenomena, are being applied with success to the problems of the glow discharge. There has been too great a tendency to keep high-pressure and low-pressure work in separate compartments, and those who are primarily interested in the low-pressure side will find Prof. Schweidler's article extremely useful.

The article on flames furnishes an admirable introduction, from the experimental side, on one hand to the physical basis of the electrical features of flame technology, and on the other to the study of stellar atmospheres.

Theory of Probability. By the late Dr. William Burnside. Pp. xxx+106. (Cambridge: At the University Press, 1928.) 10*s.* 6*d.* net.

THIS small volume, a posthumous work of Prof. Burnside, is prefaced by a short biography of the author (see also NATURE, Oct. 15, 1927, p. 555) which shows the variety and extent of his contributions to the advancement of mathematics. Apart from his published work, Burnside was responsible for a large amount of confidential matter during the thirty-four years in which he occupied the chair of mathematics at the Royal Naval College.

The book merits attention not only for the precision of its language but also for the careful statement of the rule for calculating calculable probabilities. The usual postulation of equal likelihood does not satisfy Burnside, who points out that a more fundamental postulation is that "each two events are equally likely". A discussion of this point is given in a note at the end. A valuable feature is the application of difference equations and approximate methods of solution to the calculation of probabilities involving large numbers. This book should certainly be read by all interested in the applications of the theory of probability.

L. M. M-T.

The Child of Circumstance: the Mystery of the Unborn. By Dr. Albert Wilson. Pp. xx+420+50 plates. (London: John Bale, Sons and Danielsson, Ltd., 1928.) 15*s.* net.

DR. WILSON gives us of the best of a long and sympathetic experience of human nature and of its derelicts. It is a great boon to have an understanding of the motives behind the criminals' conduct, and this the author has far more than a number of cranks who write with a very narrow knowledge of criminology and how to reform it. This is particularly so when capital punishment is being discussed. The author takes a broad and sensible view of this and thinks that if the lethal chamber replaced the rope it would be an advance in treatment. At the same time, he points out that when the death penalty is abolished, juries are more ready to convict—perhaps on less certain grounds. Unlike many who write on the subject, he recognises the viewpoint of the murdered one's relatives.

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 Oyster-drills on English Oyster-beds.

THE occurrence of the American oyster-drill, *Urosalpinx cinerea* Say, on oyster beds in the River Blackwater, Essex, was recorded in NATURE (Aug. 18, 1928, p. 241), and has since been found to be present in great numbers on the shallower parts of these beds in summer-time. This pest, which was first confused with the rough tingle, *Ocinebra erinacea* (= *Murex*), has thus become acclimatised, like its congener, the American slipper-limpet, *Crepidula fornicata*, since its introduction from America, and unless care be taken may spread to other oyster-beds. There now occur in England three oyster-drills or tingles, which in the adult state bore holes through the shells of oysters—and other organisms—and devour the body of the prey through the hole made in the shell, namely :

Urosalpinx cinerea, the American oyster-drill, or rough-tingle,

Ocinebra erinacea, the European rough-tingle, and

Purpura lapillus, the European smooth-tingle, or dog whelk.

These three snail-like tingles are shown together in Fig. 1 ; and by isolating living samples of the different kinds in the tanks at Plymouth, before the spawning

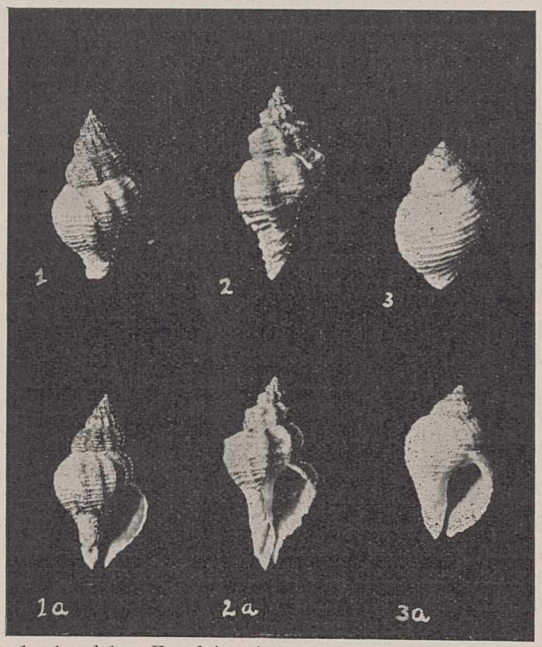


FIG. 1.—1 and 1*a* = *Urosalpinx cinerea*; 2 and 2*a* = *Ocinebra erinacea*; 3 and 3*a* = *Purpura lapillus*; all collected at West Mersea on Oct. 25, 1928. (Touched-up photographs about two-thirds the natural size.)

period in spring, their egg-capsules have eventually been obtained, and are shown in Fig. 2.

In each species, individuals lay a variable number of egg-capsules and also tend to congregate to spawn, so that large numbers of capsules may be found in clumps. The egg-capsules of each kind can, however, be easily distinguished by their characteristic shapes, as shown in 1, 2, and 3 of Fig. 2. The capsules of *Ocinebra* (2, 4, and 5 of Fig. 2) from the three different localities are not of the same size ; this difference is, however, correlated with the size of the adults. In transverse section, the appearance of the egg-case of *Urosalpinx* is oval (1*a*) ; that of *Ocinebra* is triangular (2*a*) ; and that of *Purpura* is nearly circular (3*a*). The

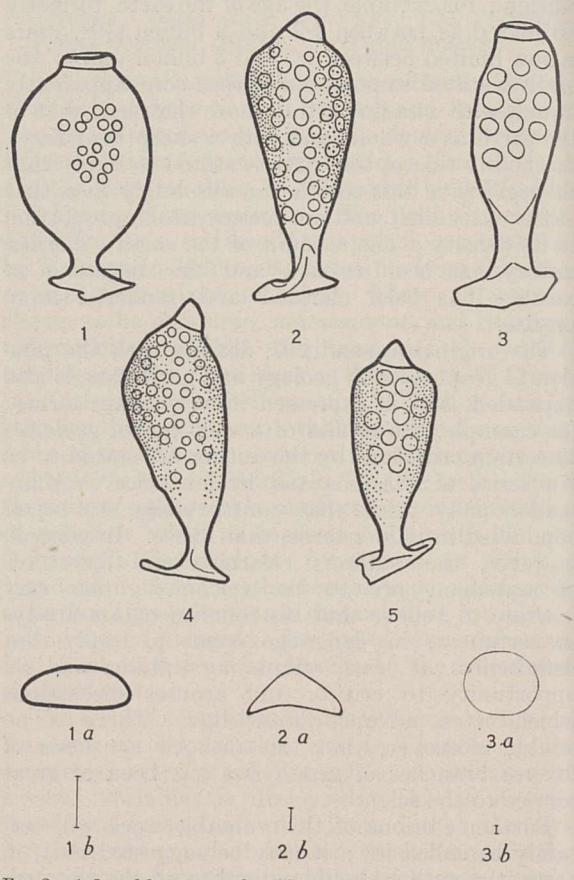


FIG. 2.—1, 2, and 3, egg-capsules of *Urosalpinx cinerea*, *Ocinebra erinacea* (= *Murex*), and *Purpura lapillus* respectively, from West Mersea, with developing embryos; 4 and 5, egg-capsules of *O. erinacea* from Falmouth and Plymouth with embryos. 1*a*, 2*a*, and 3*a* are transverse sections of the capsules of *Urosalpinx*, *Ocinebra*, and *Purpura*. (All the drawings are made to the same scale.) 1*b*, 2*b*, and 3*b* represent diagrammatically the relative thickness of the capsules of the three forms.

wall of the capsules of *Urosalpinx* and *Purpura* is uniformly thickened, whereas that of *Ocinebra* is thicker at the two ridges than in the rest of the case (2*a*). Sections at various levels of the egg-capsules show no difference in thickness of the wall. From the illustrations of the transverse sections, it will be observed that the wall of the capsule of *Urosalpinx* is thicker than that of *Ocinebra*, which in turn is thicker than that of *Purpura*. The relative thickness is as 7 : 3 : 1, and is demonstrated in the vertical lines 1*b*, 2*b*, and 3*b*; actual measurements are approximately 70 μ, 30 μ, and 10 μ.

The number of embryos in the capsules, as shown in 1, 2, and 3 (Fig. 2), differ greatly. These differences may, however, be specific, or due to age, or to the artificial conditions under which the eggs were laid. In the capsules of *Purpura* (3) and *Ocinebra* (5) there are fewer—but older—embryos than in those of the other specimens, but it is known that in *Purpura* the greater number of eggs is absorbed to provide nutriment to a few surviving embryos (Pelseneer, in

"Treatise of Zoology", vol. 5, Mollusca, p. 21, edited by Sir E. Ray Lankester), and it is probable that the same phenomenon holds good for *Ocinebra*.

It will be interesting to follow the distribution of the American drill in the future, but as the young individuals of this species do not pass through a free-swimming larval stage, unlike *Crepidula*, their dissemination is likely to be very slow. Fresh introductions may, however, be made at any time on American oysters imported on beds in or outside the Thames Estuary area, so that the illustrations given above may help either in preventing the spread—or a fresh introduction—of such a pest, as may indeed render unprofitable the work of experienced oyster-cultivators (see NATURE, **120**, 653; 1927).

J. H. ORTON.
C. AMIRTHALINGAM.

Marine Biological Laboratory,
Plymouth, July 22.

Growth-gradients and the Axial Relations of the Animal Body.

PROF. HUXLEY'S letter in NATURE of June 15 raises a very interesting feature of animal organisation which I have myself been studying recently. Briefly, in certain aspects of the growth of Crustacea there are gradients which do not decline uniformly and simply from front to rear in the manner originally put forward by Child for certain worms ("Growth and Senescence", 1915: "Individuality in the Animal Kingdom", 1916), but present a multiplicity with one or more peaks at points of great differential growth, the maximum lying at the level of the chelæ in males or in the abdomen at certain stages of female *Carcinus*.

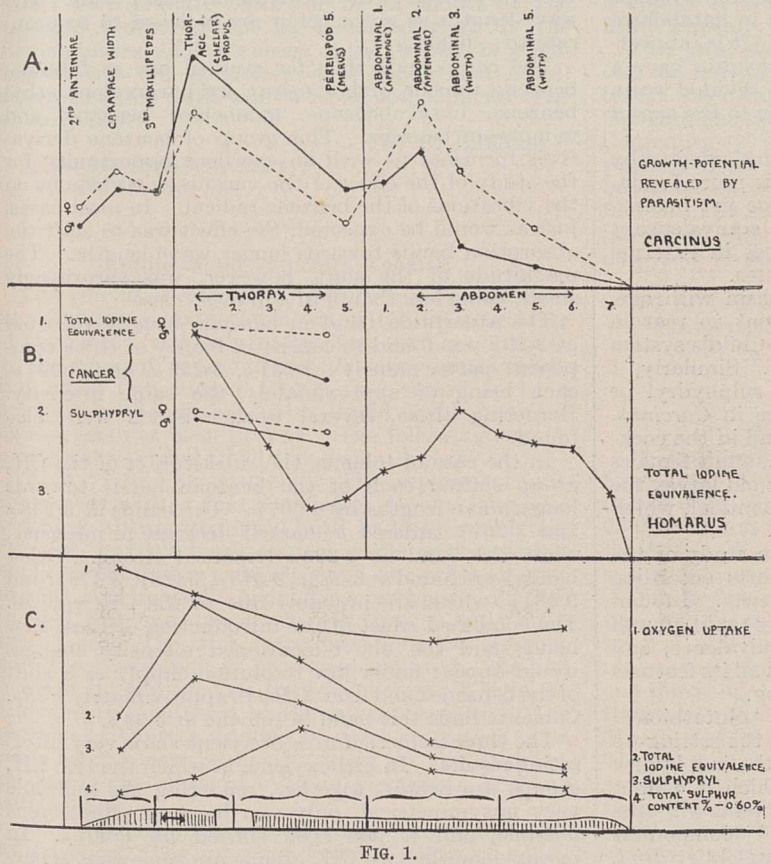


FIG. 1.

Analysis of the conditions in *Carcinus* of both sexes at different ages and when parasitised by *Sacculina* has suggested that relations between different parts of the body depend upon two considerations:

(*a*) The existence of varying degrees of differential or dysharmonious growth in which each structure exhibits a characteristic 'differential growth ratio' (Huxley, 1924), which may, however, change with uniform exponential acceleration or decrement over more than a whole year, and is not quite alike on the two sides.

(*b*) The competitive effect of great growth in the chelæ, etc., at certain times, which restrains the simultaneous growth at other less rapidly growing points even if they exhibit a similar tendency to increasing growth. Precisely analogous conditions have been demonstrated by Champy in Amphibia ("Sexualite et Hormones", 1924).

The effect of the parasite is to eliminate the increasing acceleration of one part over another part chiefly by reducing the 'differential growth ratio', and from relief of the restraint imposed by rapidly growing structures like the chelæ a relative increase results in the slowest parts, which is very obvious in the abdomen of males though perhaps most typical in the antennæ of both sexes. By comparison of the actual measurements with a chart prepared to show different rates of relatively accelerating growth under the competitive restraint of the most rapid, it has been possible to deduce the inherent rate of growth of other parts as compared with the chelæ uncomplicated by the effects of competition, thus using the parasite to perform a physiological experiment which could not be procured by any surgical means.

The gradient thus revealed by the parasite is typical of a long series of anatomical relations which have been found in *Carcinus* of 15-60 mm. carapace-length, that is from one to three years old, which include:

(1) The proportional size of structures expressed as a percentage of the carapace-length at any age.

(2) The percentage increase in size of structures for 100 per cent increase of carapace-length between any two ages.

(3) k in Huxley's heterogonic formula (NATURE, **114**, 895; 1924)

$$\text{Structure-size} = b \times (\text{Body-size})^k$$

obtained from the slope of a log log plot of the structure against carapace-length.

(4) The exponential rate of change of k between 25 mm. and 50 mm. carapace-length.

(5) The range of variation of different structures expressed as a percentage of the size of the part concerned.

(6) The proportion (percentage) of individuals which exhibit asymmetric development at the various levels.

(7) The proportion of asymmetric individuals which are right-handed at the different levels (autotomy and variation allowed for), or the bias of symmetry given by the formula

$$R - \frac{L+R}{2} = B,$$

where B is the amount of bias to right (+) or left (−), R and L the number in 100 crabs which are right or left handed, taking care to note the incidence of autotomy on one side or the other and to deduct an appropriate percentage the condition of which was probably due to this extraneous cause.

(8) The inherent growth-potential revealed by the effects of the parasite *Sacculina* (Fig. 1, *A*).

All these gradients are so very similar as to warrant the conclusion that their forms depend upon the same system. The last (8) is published here as a typical example, and it will be noticed that it corresponds closely with the gradients for relative size (*Inachus*) and percentage increase with 100 per cent carapace increase (*Palæmon*) published in Prof. Huxley's letter.

Perhaps the most remarkable feature of these complicated gradients is their general correspondence with a gradient of extractible reduced 'glutathione' or sulphydryl and other reducing compounds titratable with iodine, which unfortunately cannot for lack of tissue be demonstrated outside the thorax of crabs but has been found more completely in the lobster (Fig. 1, *B*). In earthworms (Fig. 1, *C*), I find that the gradient of growth corresponds with the gradients of total iodine equivalence (*C*, 2), extractible sulphydryl (*C*, 3), and total sulphur (gravimetric) (*C*, 4), and not with the gradient of total metabolism (*C*, 1) observed by the oxygen uptake; the last, therefore, includes other oxidation systems which it is legitimate to suppose result in katabolism rather than the anabolism of growth. It is interesting to find that gradients in the earthworm have a summit at about that point whence a divided worm grows forwards or backwards according to the aspect of the cut surface.

I find that the diminution in sulphydryl effected by *Sacculina* (NATURE, **120**, 654; 1927) is more fundamental than any other chemical change yet investigated, and along with the total iodine equivalence it is more closely associated with changes in external anatomy than are other chemical features.

The well-known decline of metabolism with age, corresponding to the decline from front to rear in planarians, is an important element in Child's system of animal organisation and gradients. Similarly, I have found a decline of extractible sulphydryl or iodine equivalence with advancing age in *Carcinus*, *Pandalus*, the embryos of *Sacculina*, and in the cockroach (*B. orientalis*). In the last form, adult females were found to be closely similar to the old larvæ, the external anatomy of which is almost identical, whilst the males presented a further advance.

Champy (l.c.) has made an elaborate study of the interrelationship of the growth of parts according to maturity, season, and nutrition in newts. I found that in these animals points of relatively rapid growth were characterised by high iodine equivalence, and that there was a close correspondence in all its features with the system worked out by Champy.

There is an attractive feature of the 'glutathione' system which might be held to explain the setting-up of gradients. An important part of the sulphydryl is rigidly attached to protein from which it cannot be washed free; it is also found that proteins will take up sulphydryl from solutions of 'thiol' compounds (vide "Glutathione" by H. E. Tunnicliffe, *Biol. Reviews, Camb. Phil. Soc.*, **2**, pp. 84-86). It may be supposed that when new protoplasm is laid down, the sulphydryl content of its protein (which would afterwards control the total content in equilibrium) is determined by the concentration of free sulphydryl in the fluid bathing its situation of origin, and since that is a portion only of the total parental content, it follows that a gradient might be set up. Autolysis of tissue accompanying abrupt larval metamorphoses might result in the development of new growing points with new gradients connected to their fellows by transitional gradients necessitated by the processes of diffusion. The decline with age would result from the preponderating accumulation of daughter protoplasm of lower value.

These observations were made in the course of an extended study of the effects of *Sacculina* on *Carcinus* made at Cambridge in the Sir William Dunn Institute and in the Zoological Laboratory, the details of which will be published in due course.

MICHAEL PERKINS.

5 Little Cloisters,
Westminster Abbey, S.W.1,
July 8.

Fine Structure of Infra-Red Absorption in Organic Compounds and the Raman Effect.

THE infra-red absorption bands of nine organic liquids have been studied in the 3·5 μ region. The spectrometer employed made use of an eschelette grating, which had a resolving power of 10,000 as compared with approximately 170 for a 3-inch rock-salt prism in this region. The dispersion was such that, with the slits 0·25 mm. wide, one slit width contained a portion of the spectrum only 25 A. wide. The wave-lengths as given below are believed to be accurate to $\pm$ 0·003 μ.

The compounds thus far studied are as follows: benzene, toluene, ortho-, meta-, and para-xylene, ethyl benzene, butyl benzene, monochlor benzene, and monobrom benzene. This group of benzene derivatives furnishes us with an excellent opportunity for the study of the effect of the various substitutions on the vibrations of the benzene radical. In most cases, just as would be expected, the effect was to shift the absorption bands towards longer wave-lengths. The magnitude of the shift, however, was surprisingly small, being less than 0·01 μ in every case.

The absorption band in benzene usually reported at 3·25 μ was found to consist in reality of three component parts, namely: 3·231 μ, 3·253 μ, and 3·291 μ, each being of approximately the same intensity. Bordering these, several weaker bands were also found.

In the case of toluene, the substitution of the CH_3 group shifted each of the benzene bands towards longer wave-lengths by 0·007 μ. The bands at 3·238 μ and 3·261 μ suffered a marked decrease in intensity, while the band at 3·298 μ remained strong. Other bands were found at 3·278 μ, 3·343 μ, 3·428 μ, 3·478 μ, and 3·481 μ, which are probably due to the CH_3 radical. The combined effect of the introduction of these new bands and the above-mentioned intensity changes would appear under low resolution simply as a shift of the benzene band from 3·25 μ to approximately 3·35 μ. Coblentz finds this band in toluene at 3·34 μ.

The three isomeric forms of xylene show very interesting results. In orthoxylene, in which the two CH_3 groups are nearest together, rendering the molecule very unsymmetrical, only one benzene vibration is possible, and it has been shifted by 0·007 μ. In metaxylene the two CH_3 groups are somewhat separated, having replaced two alternate hydrogen atoms in the benzene radical. Here the 3·291 μ band occurs without having suffered a shift, while the other two are absent. However, in paraxylene, the CH_3 groups replace two diametrically opposite hydrogen atoms, and therefore the molecule is still symmetrical, just as in the case of pure benzene. We would expect the

effect here to be very small. In fact the 3·231 μ and 3·291 μ bands each occur just as in benzene except for a slight decrease in intensity. The 3·253 μ band is entirely absent.

In each of the xylenes, a group of strong complex bands, apparently due to the two CH_3 radicals, occurs in the region from 3·3 μ to 3·5 μ. The exact locations of some of these bands vary slightly for the three forms. Coblentz gives a single band, the same for each form, the wave-length of which is 3·38 μ, while several other observers give 3·39 μ.

Similar results were obtained for the other four compounds. In some cases all of the benzene bands were present and shifted, while in others only intensity changes were noted. In still others, some of the benzene bands were entirely missing. In no case was a shift found which could possibly exceed 0·01 μ.

This work was undertaken for the purpose of obtaining a correlation between the infra-red absorption spectra and the Raman spectra for various liquids. Using the Raman photographs taken by Prof. R. W. Wood (*Phil. Mag.*, vol. 7, No. 45, p. 858 ; 1929) an excellent qualitative agreement was found in every case. That is to say, for each Raman line an infra-red band was found which very closely checked it in regard to frequency. However, many infra-red bands were found which apparently were not predicted by the Raman photographs. Where, for example, the latter might give four lines, some 15 or 20 infra-red bands were found. Since the detail shown by the infra-red measurements far exceeded that by the Raman plates, an exact check of the two sets of wave-lengths was not possible. It is hoped that a full account of this work will be ready for publication at an early date.

R. B. BARNES.

Johns Hopkins University,
Baltimore, Md.

Liquid-Solid Interface Tension.

THE convex meniscus of mercury can be explained by assuming a state of tension in the limiting layer of this liquid, not only at the free surface, but also in the area of contact with the containing vessel. But while free surface tension has ceased to be a hypothesis, the reality of a liquid-solid interface tension has not been proved. The following experiments are intended to fill this gap.

(*a*) A 'liquid pincushion'. The experiment succeeds best with a fine steel wire, 2½ cm. long and weighing about 10 mgm., both ends of which are rounded, but the finest sewing needle in the market applied head downwards, although somewhat stouter, may be used instead. A small, concave porcelain dish is filled with mercury to the depth of a little more than 1 cm. The wire, introduced into the mercury and then released, is of course rejected, but the moment its end touches the solid bottom it loses its buoyancy and adheres to the smooth surface of the porcelain. Quite a number of wires or, with a little care, needles can be fixed upright in this manner, producing the effect of a liquid pincushion bristling with needles.

This peculiar phenomenon admits of one interpretation only. The interface layer of mercury which surrounds the submerged part of the wire, and that which clothes the surface of the porcelain, must both be assumed to be in a state of tension. When the steel touches the porcelain, the two layers become united and forthwith contract into the smallest possible area. The result is a withdrawal of the liquid from the capillary space between the rounded end of the wire and the porcelain. The mechanical effect of this withdrawal is twofold :

(1) As there is no more mercury beneath the terminal surface of the wire, the liquid pressure acts on it horizontally only, and there is no more upward lift.

(2) The capillary space just mentioned has been converted into a diminutive vacuum towards which the surrounding mercury turns a *free surface*. It is the tension of this circular zone of free surface which pins the end of the wire to the smooth surface of the vessel and holds it there.

(*b*) The Gibbs-Thomson principle. One of the manifestations of this principle is the concentration (W. Ramsden, *Transactions of the Liverpool Biological Society*, vol. 33, 1919) of a solute in the surface layers of its solution. In extreme cases, saponin and albumin solutions for example, the surface layers solidify and can be separated from the solution in the form of a solid membrane. It is characteristic of all such solutes that they lower the surface tension of the solution. In the light of this knowledge the following observation is of theoretical interest.

A watchglass is filled with mercury, and a small quantity of zinc, or of the less soluble copper, is dissolved in the liquid. Very soon the surface loses its lustre, and a soft but solid film is formed all over it. This film, which is a mercurial alloy, is thick and gray in the case of zinc, thin and of a golden brown if copper is used. If it is brushed away, it rapidly forms afresh.

This solid film covers not only the free surface but also the interface, into which it is continued without a break. Seen from below through the glass, the interface film has the same appearance as the surface film. Consequently, if the latter owes its existence to the working of the Gibbs-Thomson principle, then it may be taken as extremely probable that the interface film has the same origin ; in other words, that the interfacial layer of mercury is the seat of a considerable store of potential energy and of tension.

MAX LOEWENTHAL.

160 Princes Road,
Liverpool,
July 11.

Coal Reserves of China.

IN the leading article "Coal, Iron, and World Peace," of NATURE (Aug. 3), the coal reserves of China were discussed. The amount was taken as 23,000 million tons from the cautious calculation of Dr. W. H. Wong. This numerical value seems to be not quite correct.

Only a few months ago, in a private communication, Dr. Wong informed me that recent investigation by him and his colleagues has put 302,000 million tons as the total coal reserves of China. This is nearly one-third of Drake's estimate ; and eight times Inouye's. Drake over-estimated the coal reserves of Shansi, the most important coalfield of China, as 714,000 million tons ; Chinese investigators now give a round number of 127,115 million tons only. The coal reserve of Manchuria now estimated as 2950 million tons, was under-estimated as 1209 million tons by the older workers. They also neglected not less than 1000 million tons of coal in the provinces known as Inner Mongolia. The lignite reserves of North Manchuria and of Szechwan are not known definitely even at present.

If we draw a line with its origin at Peiping (Peking) extending both north-eastward to Harbin and south-westward to Chungking of Szechwan, then within a

few hundred miles along both sides of this line there are rich coal fields and other mineral resources on which 'the mechanised form of civilisation' of young China will be based.

Although I quite admit, and I have repeatedly warned my fellow-countrymen, that there is a deficiency of mineral resources in China, it is still possible for the western Pacific to play an important part both in the mechanised civilisation and in the world peace. Not with 'Oriental exaggeration', but with Sir Thomas Holland's brilliant presidential address, I would believe that the mineral wealth of China, if not counted as per head, but per "homogeneous national unit", is only next to that of the British Empire and that of the United States; and China is sufficiently qualified to be one of the few peace-keepers of the world provided her resources can be developed by her own energy. The awakened Chinese know their debt to the new civilisation.

K. H. LIH.

6 Denbigh Road,
London, W.11.

MR. LIH'S letter provides early confirmation of the expectation expressed in the article that further investigations would lead to the increase in the estimated coal reserves of China. The new estimate by Dr. Wong, as reported by Mr. Lih, is an increase of more than thirteen times from that quoted in our article from the "China Yearbook", p. 124, 1924, and apparently it does not include all the Chinese areas in which coal is known to occur. Even if the estimates are not further raised, 300,000 million tons is a useful lot of coal.

THE WRITER OF THE ARTICLE.

Courtship Displays of Birds.

IN his theory to account for the occurrence of 'mutual' and 'dimorphic' courtship displays in birds, Prof. J. S. Huxley states that "in birds in which the sexes are quite or almost similar, and both adorned with bright colours or special plumes or other structures, which are displayed or otherwise used in sexual ceremonies, both sexes play a quite or nearly similar rôle in 'courtship'" (*Jour. Linn. Soc.* (Zool.), **35**, p. 253; 1923). Conversely, a dimorphic courtship is found where no such epigamic characters are developed, or where the sexes differ in structure or coloration.

In view of this, it seemed likely that the courtship of the sheldrake (*Tadorna tadorna*) would be an interesting test-case; for, on one hand, this species is closely related to the ducks, where courtship is predominantly a male display, the female being usually more soberly coloured; and, on the other, the male and female sheldrake differ from the true surface-feeding ducks in being almost exactly alike, and as brightly coloured as any bird in England. For this reason, Kirkman ("British Bird Book", vol. 4, p. 216; 1913) was led to predict a mutual type of courtship.

I was able to make a series of observations in 1928 and again this spring, and found the usual courtship typical of the ducks; that is, the preliminary display is made by the male, and consists of bowing movements with several variants. The female's active part is only informative, restricted to the adoption of the pairing attitude. But in addition to this, on a very few occasions, both birds dipped their scarlet beaks into the water repeatedly, the female straightening out into the pairing position as she did so. Pairing followed this in two cases. Again, on two occasions, both birds made two or three short dives together *after* pairing, when normally they preened and flapped their wings like other ducks. These were the only actions observed which could be called 'mutual', and together occupied but a few minutes out of some fifty hours watching. The sheldrake cannot therefore be placed in the same category as the grebes, egrets, gannet, etc. It may be added that the wetting of the beak is found in other duck-courtships.

There are exceptions to the theory among the passerine birds also. Perhaps the conspicuous black of the rook is not to be considered as a bright colour, but I have seen a redbreast, which would certainly fall into Prof. Huxley's 'mutual' class, parade before its mate in the same way that the house-sparrow and chaffinch do. It seems premature to generalise about so complex a subject, for it is at least possible that the general form of the courtship of a group of birds antedates the development of specific epigamic coloration in evolution.

V. C. WYNNE-EDWARDS.

Marine Biological Laboratory,
Plymouth, July 22.

Growth and Longevity of Whales.

IN his letter to NATURE of June 15, p. 910, Mr. Gray suggests that there is evidence that the Greenland whale grows and multiplies slowly, and attains a considerable age, and he contrasts this with the conclusion mentioned in my paper at the British Association, 1928, that blue and fin whales reach sexual maturity in a comparatively short period. He refers (1) to the length of the Greenland whale and its whalebone at different stages of the whale's growth, (2) to the absence of any sign of increase in the numbers of this species, and (3) to the finding of old harpoons in Greenland whales.

1. It is not explained on what evidence the lengths of the Greenland whale at birth, weaning, and sexual maturity are arrived at, and even if the figures mentioned are accurate, it does not necessarily follow that maturity is reached only after a comparatively long period. The growth of the whalebone should be considered with caution in this connexion, for there is evidence that it undergoes a sudden increase in length immediately after weaning.

2. It is true that the early attainment of sexual maturity would favour comparatively rapid increase or replenishment of numbers, but we have to set off against this the very slow rate of reproduction; for a female, at least in the case of blue and fin whales, normally gives birth at intervals of not less than two years, and, except on very rare occasions, brings forth only one young at a time.

3. In view of Mr. Gray's evidence from the finding of old harpoons, it is difficult to avoid the conclusion that the Greenland whale may reach an age of forty years or more. It is possible that this species attains to a greater age than the rorquals, but I do not in any case think it impossible that, say, a blue whale might live to an age approaching forty years, though it seems probable that the majority of those killed in the sub-Antarctic are very much younger than this.

I should perhaps mention that the question of the growth and age of blue and fin whales is discussed in detail in a paper, now in the press, by Mr. J. F. G. Wheeler and myself, dealing with part of the Discovery Investigations.

N. A. MACKINTOSH.

c/o The Secretary,
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London, S.W.1.

Phototropy in Inorganic Compounds.

So far no coherent or consistent explanation of the phenomenon of phototropy has been given, although numerous compounds which manifest this property have been studied. A study of the phototropy of dithiotrimercuric salts of the general formula $2HgS.HgX_2$ or $2HgS.HgX$, according as X is the negative ion of a monobasic or a dibasic acid, has revealed the interesting result that the phototropy in these compounds is due to the decomposition of the compound by the absorption of actinic energy, forming mercuric sulphide and the other mercuric compound, and hence the compounds blacken in sunlight. When preserved in the dark, they again recombine with the emission of radiant energy, giving the original compound.

The ease and facility with which the direct combination takes place in the dark depends in large measure on the fine state of division in which the constituents separate themselves on exposure of the original compound to direct sunlight, and even microscopic examination of the exposed phototropic substance fails to reveal its heterogeneous character. Further confirmation for this explanation has been found in the fact that when the constituents are obtained in a fine state of division either by intimate grinding or by rapid precipitation, and then mixed in proportions determined by the general formula and boiled with water, the compound is formed.

The phototropic substance, as has been stated, represents a molecular mixture of two simpler constituents. If one of the two constituents can be removed by an inert solvent, the residue should no longer manifest the phenomenon of phototropy. This is fully borne out in the case of dithiotrimercuric salts. Thus in the case of dithiotrimercuric halides, the salts are suspended in water and exposed to sunlight with frequent shaking to ensure complete exposure and darkening of the whole salt. The chloride or bromide being soluble can be removed by water and, in the case of the iodide, a dilute solution of potassium iodide is employed. The residue is no longer phototropic and consists of mercuric sulphide.

This mixture theory of phototropy is being examined in the case of other phototropic inorganic compounds which have been recorded.

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July 2.

Rotation of the Earth and Magnetostriction.

IN NATURE of Jan. 5, 1929, p. 15, there appeared a letter from Prof. Edward S. King on a possible relation between changes in the rate of the earth's rotation and changes in the magnetic declination. Prof. E. W. Brown (*Trans. Ast. Obs.*, Yale University, vol. 3, part 6) is quoted as having shown that changes more or less abrupt occurred in the former quantity about 1785, 1850, 1898, and 1918.

As to magnetic conditions in recent years, it is probable that the observations of Eskdalemuir Observatory, for which hourly values are computed and published, constitute, over the period 1912–27, a homogeneous series from which annual mean values of declination and of at least the horizontal component of magnetic force may be derived with considerable accuracy. It is therefore of great interest to discover that an abrupt change in the rate of decrease of H occurred about 1918 and an abrupt change in the rate of decrease of D about 1920. From 1912 to 1918 the annual rate of decrease of H averaged and never differed greatly from 22γ ($1\gamma = 10^{-5}$ C.G.S. units); from 1919 to 1927 it averaged 10γ. From 1912 to 1920 the rate of decrease of D averaged and never differed greatly from 9·3′; from 1921 to 1927 it similarly averaged 12·4′.

As Prof. King remarks, the whole question is of great interest; like him, I have written this note in the hope that others, acquainted with special aspects of the problem, may pass their judgment.

A. H. R. GOLDIE.

Edinburgh, July 10.

Band Spectrum of Magnesium Oxide.

CH. M. OLMSTED noticed that magnesium oxide gives out a band spectrum consisting of several groups of bands (Diss. Bonn; 1906; *Z. f. Wiss. Ph.*, **4**, 255; 1906). He classified them into three groups: the first group consisting of bands from λ4900 downwards degrading towards violet; the second group was in the region λ4286 to λ4771; the third group was below λ3980, consisting of bands partly degrading towards violet and partly towards red. He classified them in an empirical series.

We have recently studied the band spectrum of magnesium oxide with a Hilger E_1 quartz spectrograph. There are eight distinct groups of bands extending from λ4372 to λ5700. The 61 band heads have been arranged in the usual n', n'' progression, and the $\Delta\nu'$ and $\Delta\nu''$ values of the bands can be well represented by a third degree equation using the least square method developed by Birge and Shea (*Univ. Calif. Pub.*, vol. 2, p. 67, etc.).

The vibrational constants of the molecule have been found to be as follows:

$\omega_0' = 817{\cdot}01$ cm.$^{-1}$ $\qquad$ $\omega_0'' = 773{\cdot}85$ cm.$^{-1}$
$\omega_0'x' = 2{\cdot}378$ cm.$^{-1}$ $\qquad$ $\omega_0''x'' = 2{\cdot}86$ cm.$^{-1}$

The intensities of the heads have been examined by a Moll microphotometer, and the nature of progression and the intensity relation indicate that the molecule is of the normal type having small change in the moment of inertia. The O-sequence has only four bands the intensities of which rapidly fade away, and both the +1 and the +2 sequences contain a number of bands overlapping to a large extent. A detailed investigation is in progress in this region, and also in the other regions of the spectrum, regarding the character of these bands, and results will be published elsewhere.

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June 19.

Spectrum of Trebly Ionised Argon.

WITH the aid of the extension of the irregular doublet law described by Drs. Saha and Kichlu, and the method of horizontal comparison, I have been able to effect a classification of the lines of trebly ionised argon from the data given by L. and E. Bloch (*Ann. de Physique*, 1926). All the quartet multiplets due to the transition $2M_2(N_2 \leftarrow N_1)$ have been obtained. $\Delta P_{23} = 645$, $\Delta P_{12} = 590$. $4S_2 - {}^4P_3 = \nu 42804$, and $4P_3 - {}^4\bar{P}_3 = \nu 40560$. $4P_3 - 4D_4 = 36789$.

D. S. JOG.

Physics Department,
University, Allahabad, June 16.

Agriculture and the Empire.[1]

By Sir ROBERT B. GREIG.

A PAN-AFRICAN Congress of Agriculture is meeting side by side with the Agriculture Section of the British Association, which is an Imperial body for the advancement of science. The Imperial aspect of agriculture is surely therefore a subject for consideration and discussion. Because the Empire includes so many diverse peoples differing in physical and mental attributes, and because it yields such a variety of natural products, it offers problems political, social, and industrial, of peculiar interest and complexity. Moreover, its political structure is of peculiar advantage. The free nations of the Commonwealth, along with the great non-self-governing territories, can meet without difficulty or embarrassment for the discussion of common problems. They have a focal point or centre in England from which concerted action may, if desired, be taken.

Citizenship of the Empire involves responsibilities. The governments are trustees for rich territories and for hundreds of millions of native populations. These native populations can rise in the scale of civilisation only according as they may be influenced by education, sanitation, law and order. In our colonial Empire in the past we have concentrated chiefly upon administration and we have reason to be proud of the results. But the native populations will judge us in the future not by the excellence of our administration but by the means we take to help them to a higher standard of living and to secure for them some of the benefits of civilisation.

The progress of civilisation depends upon science, not science stated crudely as chemistry or botany, but the scientific spirit applied to all aspects of life. If science is applied to the economics of the Empire, the greatest economic asset to which it can be applied is agriculture. The true wealth of the world, the wealth which determines the standard of living of nations, is limited by the capacity to produce cereals, milk, meat, wool, cotton, hides, and other prime necessities of life of soil origin. Agriculture is also the one great permanent industry, the one which is the foundation of all national or indeed of world wealth.

THE EXTENT OF EMPIRE AGRICULTURE.

The British Dominions, India, and the Colonies cover 24 per cent, or nearly one-quarter of the globe, and they contain 24 per cent, or nearly one-quarter of the world's population. Of this immense area no precise measure of the full extent of land in agricultural use is available, but the proportion is small. The most intensively cultivated of the larger areas is India, the least intensively cultivated is Australia. In the aggregate only 8·7 per cent of the total land surface of Canada, India, the Union of South Africa, Australia, and New Zealand is under arable cultivation. It is difficult to obtain figures indicative of the possibilities of the tropical and subtropical territories, but the African possessions alone are capable of enormously increased production.

In the nine provinces of Canada the 'possible farmland' is 358 million acres, or about one-quarter of the total land area of the provinces, and five and a half times the present total of both arable and pasture. In India, the most intensively cultivated, it is estimated that the cultivable waste land is equal to half the present cultivated area, or about 153 million acres.

Some evidence of the importance of the grasslands of the Empire is obtainable from the numbers of the world's live stock. Of every hundred head of cattle in the world, forty-four graze on Empire pastures, and of every hundred sheep, thirty-eight are in the Empire.

It is easy to realise the importance of agriculture in Canada or Australia, but in an industrial and mineral country such as Great Britain and in a great mineral-producing country such as South Africa, the place of agriculture is apt to be overlooked. In the three larger Dominions and even in Great Britain, agricultural production is more valuable than mineral production. It may be astonishing to some to learn that Great Britain, including Northern Ireland, produces more agricultural wealth than Australia and four times as much as South Africa. When the value of minerals is combined with the value of manufactures, even then the agriculture of Canada and Australia is more important than minerals and manufactures combined.

The distribution of the population dependent upon agriculture is best shown by such countries as South Africa, India, and Nigeria. In South Africa, in spite of its small agricultural and great mineral production, 37 per cent of the population are engaged in agriculture and only 5 per cent in mining. In India 72 per cent are dependent upon agriculture, and in Nigeria (which is three times the size of Great Britain and one-third of the size of British India) practically the whole population depends on agriculture.

It is obvious that a vast area of the Empire is capable of further production, even if developed only on the present lines with the application of existing knowledge. But if we apply not only the science now at our disposal but also the results of further investigations which are sure to follow, the potentialities become almost incredible.

RELATION OF SCIENCE TO AGRICULTURE.

Agriculture can be regarded as the application of all the sciences to the exploitation of the soil. There is scarcely a branch of pure science which may not contribute some knowledge which agriculture can apply. But agriculture differs from other industries in which a new discovery may be followed by a sudden transformation in methods. Agriculture is old, slow-moving, and conservative. The life cycle

[1] From the presidential address to Section M (Agriculture) of the British Association, delivered at Pretoria on Aug. 1.

of animals runs into years, and even in cropping a rotation of years must often be followed to get the full effects of any change of method. Hence the results of research are absorbed slowly and almost imperceptibly into farming practice. Nevertheless, there have been numerous instances when the advance has been so rapid that the farmers applying the knowledge have been within sight of the source of the knowledge.

The case of 'Marquis Wheat' is well known. This wheat, bred by the Canadian Experimental Station at Ottawa, has by its earlier maturity and superior cropping powers not only ousted the older and inferior varieties of wheat in millions of acres of Canada and the northern United States, but it has also made the cultivation of wheat possible in areas where wheat could not be grown before. A variety of sugar cane has recently been produced in Java by the Dutch plant breeders there; one of its ancestors was not a sugar cane at all, but a wild reed growing in a marsh. Yet this variety, partly of reed ancestry, is greatly superior to any other, giving 15-20 per cent more sugar and resisting local diseases better than any other.

The grasslands of the Empire support at least 500,000,000 animals. If all these animals were suited to their environment, free from disease and sterility, and sufficiently nourished, their value would be far more than doubled or trebled. In discovering the cause of and the means of combating certain insect-borne diseases, Sir Arnold Theiler and his associates have saved the Union of South Africa millions of pounds. Equally spectacular is the biological control of noxious weeds, such as the prickly pear in Australia and the blackberry in New Zealand.

In the field of animal nutrition, it has been discovered that diseases may be caused in farm stock by the absence of minute quantities of iodine, lime, phosphorus, or vitamins. The cure of rickets in pigs, and styfsiekte and lambsiekte in cattle, by the administration of bone meal and salt and other mineral mixtures has already saved hundreds of thousands of pounds to stock farmers. The application of the newer conception of the balanced ration which we now have as the result of the studies of physiologists and biochemists, is yielding its return in increased production.

The intensive management of grassland in such great grazing countries as Australia, New Zealand, and Great Britain is only beginning, but already it is plain that production can be doubled under skilful management.

These great achievements give us the assurance that the application of pure science to agriculture will yield results of a value many times greater than the money expended.

It is clear that there are large economic problems affecting all parts of the Empire which await solution if the Empire is to be properly developed. There is, for example, sterility and abortion in live stock. There is the pasture problem. There are insect-borne diseases. It is almost hopeless for a single individual or even a single institution to attempt the solution of any of these great problems. Each problem has so many aspects that team work is needed in the widest sense—not only between individuals, but also between institutions and between governments.

The most recent development of the work on pastures has been in connexion with their chemical composition. It has been shown that chemical composition, if it takes account of all known food constituents, is an indication of the feeding value of pastures, and it has been proved independently in various parts of the world that deficiencies of one or other nutrients required only in small amounts, are the cause of definite diseases. Further, it has been shown that if these deficiencies are made good, not only are the diseases prevented, but also production is increased and there is reason to believe that susceptibility to disease generally is decreased, and what is also of great economic importance, animals breed true instead of undergoing the well-known deterioration which takes place in improved breeds when put upon poor pastures.

The better exploitation of the pastures of the Empire is a problem which requires, for a complete investigation, the pathologist and bacteriologist to deal with the diseases which occur in deficient areas; the physiologist and biochemist to deal with the composition of the pasture and to determine to what extent it meets the requirements of the grazing animal. There is needed also the work of the plant breeder and the soil chemist for the improvement of the pasture as a crop.

To bring about a concerted and co-operative attack upon such problems as these a certain procedure seems desirable, and facilities for co-operation are now immeasurably greater than they were even thirty years ago.

EMPIRE RESEARCH.

Provided, then, that we have a large enough conception of Empire development by research the procedure should be:

(*a*) to outline the problem;
(*b*) to collect all available information concerning it;
(*c*) to make a plan of campaign;
(*d*) to find the money to finance the research;
(*e*) to find the men to do the work.

To carry out this procedure, it so happens that we are in a more favourable position than ever before in the history of the Empire. The urgent problems that arose during the War demanded a solution on immediately practical lines, and tremendous advances were made in some of the applied physical sciences. Following on this war experience, a similar spirit of co-operation has been developed in agricultural science.

In 1925 the British Government set up an Imperial Economic Committee, with an annual grant of £1,000,000 for the purpose of encouraging trade in Empire products in the British Isles. The Imperial Economic Committee recommended that the annual grant should be used, first, to create in the British Isles a voluntary preference for Empire goods, and, second, upon research to improve the

quality and supply of Empire goods for sale in Great Britain. The British Government, after consultation with the Dominion Governments, accepted the report and created the Empire Marketing Board, which is the executive body for the administration of the funds. The Empire Marketing Board early turned its attention to the encouragement of research as the second of its functions. Almost simultaneously with the creation of the Empire Marketing Board was set up the Committee of Civil Research.

It was borne in upon those who had inquired into research in the non-self-governing Colonies that much good work was lost in pigeon holes, that scientific workers were sometimes engaged on the same problems unknown to each other, that overlapping occurred, and that facilities for the exchange of information were inadequate. Accordingly, when the Imperial Agricultural Research Conference was held in London in 1927, it strongly recommended the creation of clearing stations or information bureaux for the collection and distribution of information concerning certain sections of agricultural research, and several of these bureaux are now in operation. They are all, by the unanimous decision of Empire delegates, situated in Britain. They deal with soils, animal nutrition, animal genetics, animal hygiene, plant breeding, animal parasitology, and fruit production. They are not research institutions, but in each case they are attached to research institutions, and their first directors are the directors of the research stations.

Each bureau will focus the information on the subject—will act as a gathering ground for theories and theorists, as an illuminant and expositor, and eventually we may hope, as a finger-post to new and profitable roads and by-paths of research. These bureaux, to which all governments of the Empire have agreed to contribute, embody the first organisation which is Imperially owned and Imperially governed, and which has been set up to serve the Empire. Each Dominion or Colony has its own problems peculiar to its conditions, but the fundamentals of science are everywhere the same.

We have, then, machinery to deal with three of the five necessities for Empire research. We have the bureaux to collect information. We have the Committee of Civil Research to consider the information and plan a campaign, and we have the Empire Marketing Board to provide the funds. As to the men, the great Dominions can and will provide and train their own men. The success of South Africa in the production of research workers whose reputation is world wide is sufficient evidence of what the Dominions can do. The case is different in the Colonies. As a rule, the research workers in the Colonies must be recruited from home or dominion sources and partly trained outside of the Colonies which they serve.

There is one aspect of the man power that must not be lost sight of in considering Empire research, and that is the desirability of exchange of workers. Nothing can be more profitable and stimulating in suitable circumstances than change of environment to the research worker. He obtains a new lease of scientific life, a wider outlook, a wealth of experience of men and methods denied to him as a limpet in an institution. There are difficulties in the way of exchanging workers on any considerable scale, but these difficulties will decrease as time passes and the temporary exchange of work and of workers will prove of far-reaching benefit.

We have available organisations or machinery capable of doing great things for the development of the Empire. Already much has been achieved. The Empire Marketing Board in two and a half years has made grants up to the end of 1928 aggregating to a million and a half pounds. A fine example of what has already been done in Imperial team work is offered by the grassland research. The headquarters of this research is in Aberdeen and the chief of staff is Dr. J. B. Orr. Under his direction, teams have been investigating the mineral deficiencies of pastures in Kenya, in the Falkland Islands, in Palestine, and in Scotland and England. Arising out of these investigations and those of Sir Arnold Theiler, similar campaigns have been started in Australia and New Zealand. Here in the space of only two or three years we have, through vision and staff work, an Imperial investigation which promises to increase enormously the output of beef and mutton from Imperial grasslands.

As a result of these pasture researches, the workers engaged have been in consultation with each other, and a spontaneous tendency to co-operation is bearing fruit. In consequence, the pioneer work of Onderstepoort is known and appreciated in Great Britain and elsewhere and is being applied successfully. The work of Aston in New Zealand on ' bush sickness ' is being applied in East Africa. The Canadian work on the prevention of goitre in grazing animals is a stimulus to work in other countries such as Australia and New Zealand, where there is believed to be a deficiency of iodine in the pastures. If similar developments can take place in other lines of research there is a possibility of great advances during the lifetime of the present generation.

We have the only system of government in the world that can link up research in countries with all kinds of soils and climates. We have the finest and most varied laboratory in the world. We have the nucleus of an organisation and we have the opportunity.

Within the Empire is the Empire's greatest market for agricultural produce and the Empire's greatest source of supply. The development of agriculture would have an enormous influence in the development of Empire trade. Co-operation in research leads to better understanding between the Dominions, the Colonies, and the mother country. Conferences of research workers and administrators lead to the discovery of common aims and ideals, as was shown in the Conference of 1927, and the pursuit of common aims is one of the most enduring of ties. But the scientific man knows no boundaries; he is one of the few real internationalists in the world to-day; the knowledge he obtains is subject to no tariff, receives no bounty, is freely exchangeable throughout the world. As a scientific man—if he is within the British Empire—he may engage in the solution of larger problems than probably any other unit can provide.

What may be the end of this research ? One may speculate, but the end should surely include an orderliness, a co-ordination of parts, and a relationship of functions which should make for greater prosperity and for greater stability and freedom from temporary over- or under-production of agricultural commodities. It is not suggested that the exchange of commodities should be intra-Imperial. Even if that were desirable it is not possible. The trade of the Empire is shared almost equally between the Dominions and foreign countries. It is not that the Empire may be a self-contained and self-supporting quarter of the globe that I make these suggestions. To succeed in such an aim would be to end nowhere or to end in destruction. I make these suggestions because the nations which make up the British Empire form a political body which faces an opportunity open to no other system of governments in the world. This opportunity is the possibility that by taking thought and by organising the acquisition and the application of knowledge, the wealth of the Empire can be greatly increased, and thereby, and necessarily, the wealth of the rest of the world will be increased also. It is a far cry to an organised Empire, but if the object is worth it, the initial step is to adopt the ' view-point ' described by General Smuts. With the view-point and the mental field surrounding it come the creative ideas which in the end realise the dream. What I plead for then is the ' view-point '. Even in the prosaic occupation of agriculture, of the earth earthy, I suggest that the Imperial view-point is stimulating and creative.

The conception of an organised agriculture based upon science should, I think, be part of the mental equipment of every statesman and administrator. The same vision should inspire every research worker if, in the words of the late Lord Morley, he is to weave the strands of knowledge into the web of social progress.

If the vision is keen enough, the conception wide enough, the energy enduring, and the courage unfailing, is it not possible that the group of free nations which constitute the British Empire may demonstrate the means and lead the way to that wider world government to which every generous and contemplative mind would look ?

The Progress of the Motor Ship.

By Engr. Capt. EDGAR C. SMITH, O.B.E., R.N.

IN NATURE on Mar. 9 a short review was given of the progress of the steamship, and attention was directed to the advances made in the use of high steam pressures, water tube boilers, pulverised coal, and other means by which the efficiency of steam machinery is being improved. It was then stated that of 65,159,413 tons of shipping included in Lloyd's Register Book, 50,045,048 tons were driven by reciprocating steam engines, 9,682,063 tons by steam turbines, and 5,432,302 by oil engines.

The history of the ocean-going steamship extends over a period of about a century ; the first turbine vessel was the famous little *Turbinia* of 1894, while the first vessel driven by the modern heavy oil engine was probably a small canal barge built in 1903. In the case of the marine oil engine, as in that of the marine steam turbine, there was much pioneering work to be done before the new machinery secured the favourable opinion of shipbuilders and shipowners, and the development of the motor ship belongs almost entirely to the last twenty years. Of its growing popularity, however, there is no question, and for certain classes of vessels and for certain trades it will probably retain its position whatever advances are made in steam practice.

In 1914 the tonnage of motor ships was only 234,000, but by 1922 this had increased to 1,542,000, and the latest returns of Lloyd's Register show that no less than 40 per cent of the tonnage under construction will be driven by oil engines, and that larger and larger vessels are being supplied with oil engines. Of ships of 8000 tons and upwards now under construction, 27 will be driven by steam and 59 by oil ; of ships of 15,000 tons and above, 7 will be steam ships and 14 motor ships. Though no motor ship yet equals in size the *Majestic*, *Berengaria*, *Leviathan*, *Olympic*, or *Aquitania*, the Italian liners *Augustus*, *Vulcania*, and *Saturnia* are of 32,650, 25,000, and 23,940 tons respectively, the four British ships *Alcantara*, *Asturius*, *Carnarvon Castle*, and *Bermuda* range from 22,181 tons to 19,086 tons, and the new White Star liner *Britannic*, the largest British motor ship, launched on Aug. 6 by Messrs. Harland and Wolff, Ltd., is 680 feet long and has a gross tonnage of 26,840.

All large oil engines as found in motor ships have been developed from the independent inventions of Rudolph Diesel and Herbert Akroyd Stuart, both of whom patented engines in which the compression of the air in the cylinder caused its temperature to rise to the ignition point of the oil. Stuart's patent was taken out in 1890 ; Diesel's in 1892. Stuart's first engine was made in 1891, Diesel's in 1893, and in that year Diesel published his memoir, " The Theory and Construction of a Rational Heat Motor ".

Both inventors used the four-stroke cycle as introduced by Nikolaus Otto. In the Stuart engine fuel oil was sprayed into the air at the end of the compression stroke and was automatically ignited by a hot bulb extension to the cylinder end which was heated previously to the engine being started, but was afterwards kept hot by the explosions. In the Diesel engine, on the other hand, the air was more highly compressed and the fuel oil was injected by compressed air. No previous heating of the cylinder end was required, but the engine was started by compressed air.

The manufacture of engines working according to Stuart's plan, or the ' Akroyd ' cycle, was taken up by Messrs. Hornsby, and they were placed upon the market as Hornsby-Akroyd engines. The Diesel

engine was developed on the continent and always bore the inventor's name, and for some reason Diesel's name came to be applied also to engines working on the Akroyd cycle, and are even to-day known as 'semi-Diesel' engines.

Stuart, who was born in 1864 and died in 1927, published many documents to establish his claim as an original inventor, and by his will left £700 to the Institute of Marine Engineers for a biennial prize for the best paper on "The Origin and Development of Heavy Oil Engines". In an obituary notice of him it was said that he "belonged to that rather tragic fraternity of inventors whose achievements have not secured from the world at large the recognition they merited". Without detracting in the least from the merits of the work of Diesel, it is undoubtedly true to say that Stuart was the first to bring out an engine with high compression and with timed injection of the oil fuel, while his method of spraying the oil into the cylinder, sometimes called 'solid' injection or more properly 'airless' injection, is used in many of the big engines for motor ships.

Diesel, it may be recalled, was born in 1858 and died in 1913. He apparently fell overboard while on passage between the Continent and England, but the mystery of his disappearance has never been cleared up. He lived long enough, however, to see Diesel engines at work in land stations all over the world, and also the beginning of their adaptation to ships.

The first boat driven by a Diesel engine was a canal barge fitted with an engine in 1903 by the Paris firm of Sautter Harle and Co. Five years later the *Delo*, of 4000 tons, fitted with an engine of 1250 h.p., was placed on service on the rivers of Russia. It is, however, with the *Vulcanus*, of 1900 tons, built at Amsterdam in 1910, that the history of the ocean-going motor ship begins. This vessel had a Werkspoor Diesel engine of 500 b.h.p. The next year the *Toiler*, built by Messrs. Swan, Hunter and Wigham Richardson, fitted with an engine constructed by the Aktiebolaget Diesels Motorer, of Stockholm, went from the Tyne to Halifax, N.S., and was thus the first motor ship to cross the Atlantic. At about the same time, the East Asiatic Company of Copenhagen built the *Sealandia* and *Jutlandia*, ships of 7500 deadweight carrying capacity, and these were equipped with engines of 2500 i.h.p., by Messrs. Burmeister and Wain. By 1914 there were about three hundred motor ships at sea, but while the War led to great activity in the construction of Diesel engines for submarines, it proved unfavourable for the development of such engines for merchant ships, and it is only during the last ten years that the large Diesel engine has become a familiar sight in our marine engineering shops.

Unlike the various types of reciprocating steam engines used in the past, all marine oil engines bear the names of the firms by whom they have been developed. Thus we have the Burmeister and Wain, the Werkspoor, the Sulzer, the M.A.N. (Maschinenfabrik Augsburg-Nürnberg), the Fullagar, and the Doxford engines. All these engines work on either the four-stroke principle, which we owe to Otto, or the two-stroke principle first introduced by Sir Dugald Clerk. Sometimes they are single acting, as in the ordinary motor car engine, sometimes double acting, as in the reciprocating steam engine. At present, the majority of motor ships have engines of the four stroke, single acting type, which for small and medium power have proved most economical in fuel, lubricating oil, and repairs. The number of cylinders, of course, depends on the power required, 4, 6, 8, or 10 cylinders being used.

One of the most notable motor ships of last year was the Nelson liner *Highland Monarch*, of 14,450 tons, which had two 8-cylinder four-stroke double acting Harland-Burmeister and Wain engines of a total horse-power of 10,000, and the *Britannic* will have two similar engines, but with ten cylinders instead of eight.

With the assured reliability of the marine Diesel engine, the decision as to whether a new ship should be driven by oil engines or steam engines is now influenced solely by the considerations of the economics of the problem, except in the case of very fast ships, for which the steam turbine retains its supremacy.

With every important change in the design of marine machinery, difficulties have been met with, and the oil engine was no exception to the rule. Whatever scepticism there was as to the reliability of the marine Diesel engine has been removed by the successful motor ships now afloat, and seeing it is possible to construct petrol engines which enable aircraft to maintain endurance flights of a fortnight, there can be no doubt as to the possibility of eliminating such defects as do occur in the internal combustion engine in ships.

The economics of up-to-date steamships and motor ships was the subject of some interesting remarks by Mr. J. Johnson in his paper entitled "The Propulsion of Ships by Modern Steam Machinery", read to the Institution of Naval Architects on Mar. 21 last. Mr. Johnson was responsible for the design of the s.s. *Duchess of Bedford* and other interesting vessels for the Canadian Pacific Railway Company, which maintains services on the North Atlantic and North Pacific. Among the factors to be taken into consideration are first cost, fuel costs, weight of bunkers, and costs of repairs, and it was evident that for the particular services mentioned, Mr. Johnson held the view that the steam vessel was quite capable of holding its own against the motor ship. In some tables, he gave figures relating to two ships of 18,000 s.h.p. and 30,000 s.h.p. respectively. As regards the weight, the steam installations worked out at 4435 tons and 9640 tons, as against the 4765 tons and 9870 tons of the Diesel installations. In the steam ships the consumption of boiler oil was given as 0·63 and 0·60 per h.p. per hour, as against 0·48 in the motor ships. But owing to the much higher price of Diesel oil the daily fuel costs for the 18,000 s.h.p. ship on the Atlantic would, when running to Montreal, be £324 in the motor ship as against £262 in the steam ship, while the 30,000 s.h.p. motor ship on the Pacific would

have a fuel bill of £355 per day and the 30,000 s.h.p. steam ship £348 per day.

When the contract for the s.s. *Duchess of Bedford* was placed, quotations showed that the cost of a motor ship of similar capacity would have been £100,000 more. The price of coal, oil fuel, and Diesel oil differs at the various ports of the world, and Mr. Johnson illustrated this by a map. He also gave a tabulated statement of the coal and oil deposits of the world as at present estimated. This showed that whereas the coal deposits are equal to about 4000 or 5000 tons per head of population of the world, the deposits of oil are only equal to about 4 or 5 tons per head. It may be that superintending engineers of shipping companies at the present time are not influenced by these figures, but they have a direct bearing on the interesting question as to whether ocean transport in the future will depend on oil engines or steam engines.

Obituary.

SIR E. RAY LANKESTER, K.C.B., F.R.S.

WITH deep regret we record the death, on Aug. 15, of Sir E. Ray Lankester. For long he was the dominating figure among British zoologists, and he was recognised the world over as a great master in science owing to his achievements in biology and more particularly for his advancement of our knowledge of the morphology of animals. Those who met Lankester could not fail to see in him a man of exceptional intellectual power. His tall and commanding presence, his expressive face, his speech, all contributed to make up an impressive personality.

Edwin Ray Lankester was born in London on May 15, 1847, the eldest son of a well-known physician who became coroner for Central Middlesex. Educated in the classical tradition at St. Paul's School, London, he gained a scholarship at Downing College and went up to Cambridge at the early age of seventeen. Two years later, however, he migrated to the University of Oxford, where he entered Christ Church as a 'junior student'. Here he studied zoology, with his friend Moseley, under Rolleston, the first Linacre professor. Having graduated with first-class honours in natural science, and obtained the Burdett-Coutts scholarship in geology, and later the Radcliffe Travelling Fellowship, Lankester went to Naples in 1870, where he studied marine zoology with his friends Anton Dohrn, the founder of the famous zoological station, and Frank Balfour, the illustrious embryologist.

On his return to Oxford, Lankester was elected fellow and tutor of Exeter College, and began his teaching career. Two years later, in 1874, Lankester was chosen to fill the chair of zoology at University College, London. In 1882 he was appointed to the professorship of natural history in Edinburgh; but, finding the conditions of this post unsuitable, he resigned it within a fortnight, and was welcomed back to London, where he resumed the professorship at University College, which he retained until 1890. This was Lankester's best period, remarkable both for his success as a teacher and for the output of important original researches carried out in his laboratory by himself and his pupils.

In 1890, Lankester succeeded Moseley as Linacre professor of comparative anatomy at Oxford. Here, among his many activities, he greatly improved the laboratory facilities, and added a large modern building to his Department. He also devoted much attention to the reorganisation of the zoological section of the Museum, and the methods of displaying specimens with an eye to beauty and instruction. Of this experience he made full use when, in 1898, he was appointed Director of the Natural History Departments of the British Museum and Keeper of Zoology at South Kensington. These posts he occupied until his retirement at the age of sixty, in 1907.

Lankester's scientific work extended over the whole field of zoology. There is scarcely a group of animals he did not study, scarcely a problem he did not help to elucidate. Both his parents were cultivated people of intellectual interests. His father was a scientific man of distinction, a fellow of the Royal Society, interested more especially in microscopy, who contributed many papers to the *Quarterly Journal of Microscopical Science*, of which he was co-editor. In the congenial atmosphere of this family circle, where he met Huxley and other eminent men engaged in the controversies of those stirring days over the "Origin of Species", young Ray Lankester must have early developed that love of the wonders and beauties of Nature, that insatiable curiosity to know and understand, which inspired his work and lasted to the end of his career. Indeed, he began writing when a mere boy, and it is characteristic of the man that he never lost his interest in the subjects he took up; his enthusiasm and eagerness for fresh information were not blunted, nor did new interests crowd out old ones from his capacious mind. So we find that his first venture into print is a letter on Pteraspis (*Geologist*, 1862), beginning a series of contributions on a remarkable group of fossil fishes, and leading to the writing of the important monograph on "The Cephalaspidæ", published by the Palæontographical Society in 1868–70. This work is recognised as a classic on the subject. In 1863 appeared a note on the Gregarinidæ (*Quar. Jour. Mic. Sci.*, vol. 3), the prelude to a series of researches on parasitic Protozoa that won him a place of honour in the history of protozoology and parasitology.

The Protozoa had a peculiar fascination for Lankester, who was an expert in microscopy. Later in life he did much to promote the study of parasitic Protozoa in relation to disease at home and abroad, and the success of Minchin and others in this field owed much to his encouragement.

Lankester was only seventeen years of age when he wrote his first paper on the anatomy of the earthworm (*Quar. Jour. Mic. Sci.*, vol. 4, 1864); this

animal, he was fond of saying, is the rock on which morphology is built. From such observations he was later led to the study of the body-cavities of animals, and finally established that, while the body-cavity of annelids and vertebrates is the cœlom, in molluscs and anthropods it is of a different nature and filled with blood. This and other contributions made by Lankester have helped greatly in the clearing up of obscurities and the elucidation of many important points in the general morphology of various groups of Invertebrata, thereby laying bare their true phylogenetic relationships.

The masterly memoir entitled "Limulus, an Arachnid" (*Quar. Jour. Mic. Sci.*, 1881) is a triumph of Lankester's method, whereby he first proved the close affinity of this remarkable creature, known as the King crab, to the scorpion and not to the Crustacea as hitherto supposed. Another important line of research dealt with the development of molluscs; the memoir which followed (on "The Embryology and Classification of the Animal Kingdom", *Quar. Jour. Mic. Sci.*, 1877) contained many new and fruitful conclusions, and had a great and lasting influence on the science of embryology. His work on *Amphioxus*, and especially on its development, in collaboration with his pupil, A. Willey, also deserves special mention. On quite other lines were his pioneer researches on the pigments of animals, and his later work on flint implements. These are but a few of the subjects he studied.

In addition to these special papers Lankester wrote many works of a more general character. The articles he contributed to the "Encyclopædia Britannica", on Protozoa, Hydrozoa, Mollusca, Arachnida, Polyzoa, and general zoology, are masterpieces of scientific exposition; also his introductions to some of the volumes of the well-known "Treatise on Zoology", of which he was editor. Among his more popular, but not less excellent books, may be mentioned "Comparative Longevity" (1871), "Degeneration" (1880), "The Advancement of Science" (1889), "The Kingdom of Man" (1907), "Science from an Easy Chair" (1910), and "Great Things and Small" (1923).

It was in 1869 that Lankester, who had just graduated at Oxford, became co-editor with his father of the *Quarterly Journal of Microscopical Science*. Under his able sole editorship from 1878 until 1920 it became the leading British journal of scientific zoology.

The lasting value of Lankester's work depended, perhaps, most on the soundness of his judgment. In matters of morphology especially, a sound judgment, based on a broad foundation of accurate knowledge, a wide outlook combined with a well-trained and alert imagination, are necessary for success, and these are just the qualifications Lankester possessed. Eager as he was to hear of new discoveries, he was not easily led astray by the extravagant praise of some new theory. He delighted to share his knowledge with others, and to rouse in them the interest he so deeply felt. Hence he was a great teacher. In the simplest language he could give vivid descriptions or lucid explanations; with impressive mastery he could marshal the evidence and develop his argument. But perhaps his most precious gift was his power of selecting the essential, of picking out the important and discarding the unimportant. Neither in conversation nor in lecture were his statements obscured by irrelevant detail. He delivered inspiring lectures spontaneously, often without notes of any kind, trusting to his memory, to the specimens on the table, and the diagrams on the wall. He would illustrate them by skilfully executed drawings in coloured chalks on the blackboard.

Always ready to help and advise colleagues or pupils, Lankester took the keenest interest in their work. When consulted he never seemed at a loss for a helpful suggestion or an appropriate comparison drawn from his vast store of well-ordered knowledge. To any sincere inquirer he gave unselfishly of his best; those who worked with him owed much to his inspiration, for which he claimed no credit. But he never forced his opinions on them, and allowed them free choice to pursue their own lines of research.

Lankester's services to the cause of protozoology and medicine have already been mentioned. Even more has zoological science in Great Britain benefited by his help in the foundation of the Marine Biological Association and the erection of its Laboratory at Plymouth. For long he took an active interest in its welfare, and the proud position this laboratory now holds as a centre of biological research is largely due to him.

The reputation of Ray Lankester at home and abroad was great. Elected a fellow of the Royal Society so early as 1875, he was awarded the Royal Medal ten years later and the Copley Medal in 1913. From the Linnean Society he received the Darwin-Wallace Medal and the Gold Medal. A knighthood was conferred on him on his retirement from the British Museum. He received many honours from universities at home, and from numerous learned societies on the Continent and in America.

Lankester was a man of strong feelings, which he did not hesitate to express. Any form of sham, fraud, or injustice roused his anger, and his impetuous temperament sometimes led him into difficulties, even injured his worldly prospects. But he had high ideals and a kind heart. His many interests, artistic and literary as well as scientific, his great personal charm, won him many friendships. During his frequent visits to the Continent he made friends with most of the eminent zoologists of his day.

His friends will mourn his loss, but his work will remain and bear fruit, the best memorial to a life devoted to the advancement of science.

E. S. GOODRICH.

ZOOLOGICAL teaching in the broadest sense, including animal physiology, was given a new impetus in Oxford by the completion of the University Museum about 1860, in Cambridge by the inspiring personality and administrative power of Michael

Foster. The Oxford Museum, owing its existence to the prophetic vision and untiring efforts of Henry Acland, in alliance with the genius of Ruskin, began its work with George Rolleston as the forceful and arresting head of the "Linacre Department of Human and Comparative Anatomy and Physiology", the parent of four separate Departments—Zoology and Comparative Anatomy, Human Anatomy, Animal Physiology, and Anthropology.

Three great names—Balfour, Lankester, and Moseley—will always be associated with the revival of zoological learning in our two ancient universities; for it was in this period that their student years were passed, and each of them rendered invaluable service to his Alma Mater as a teacher, and, above all, as an inspirer of research.

Lankester was fortunate in his boyhood, living in a home which enjoyed the friendship of such leaders of scientific thought as Huxley, Edward Forbes, Hooker, Henfrey, Tyndall, and Darwin—to mention the names which arose in his mind in association with the centenary of Huxley's birth. After gaining a scholarship at Downing College, Cambridge, in 1864, Lankester paid a vacation visit to Oxford, and, as he has told me, was at once attracted by Rolleston's enthusiasm and all the interesting and stimulating excitement of the Linacre Department making its fresh start in the New Museum. He resigned the scholarship at Downing and in 1866 gained a Junior Studentship at Christ Church.

Lankester had taken his degree five years before I first went to Oxford in 1873. He had lectured in the Museum under Rolleston until the inevitable had happened and the two men separated—Lankester to teach in a laboratory fitted up for him at Exeter College, of which he had become a fellow and lecturer in 1872. Memories of that fellowship examination, with Huxley and Rolleston as examiners, reached me in the following year, and from them I learned that there were only two candidates—Lankester and Sharkey (now Sir Seymour Sharkey). The latter devoted his whole time to a single question—the functions of the spleen; Lankester to zoology in the strict sense. The work of both candidates was so admirable and so incommensurable that no award was possible on the examination, and Lankester was elected as the senior, and probably also because his subject was thought to be more useful for the students of that day.

Of the three Oxford Colleges with which Lankester was associated—Christ Church, Exeter, and Merton—Exeter was always nearest to his heart. Here were his dearest friends—Bywater, Pelham, and Jackson, and later on Moseley—and it is in the Hall of Exeter that his gift, the admirable portrait by John Collier, has hung for many years.

To one bound as I was to the Museum as an undergraduate and later as a demonstrator, Lankester and the Exeter laboratory were something of a mystery; but some of the students attended both institutions, and I remember D'Arcy Power (now Sir D'Arcy Power) telling me of the excellence of the zoological teaching in "the other place". There also remained on the hidden side of a blackboard a beautiful drawing in coloured chalks of a sea-urchin—a lingering memory of the time when Lankester lectured in the Museum; and, after many years, I was told that Rolleston had so far forgotten the old bitterness as to turn the picture round and explain it to the students.

Our long friendship, begun in 1883, when I went to see him in London about some papers for the *Quarterly Journal of Microscopical Science*, became close and intimate when he became deputy Linacre Professor during Moseley's illness and succeeded to the chair in 1891. Our gardens were only separated by a low wall, and some of the steps by which an easy passage was effected are still in existence. In 1893 we became colleagues, and I can never forget the warmth of his welcome to me as a brother professor.

Lankester's scientific career will be described by others who were more closely associated with his teaching and researches. I propose to speak of other sides of his personality as they were revealed in a friendship of more than forty-five years.

Only those who knew Lankester well can realise the warmth of his affection for his family and his friends, and the depth of his sympathy with them when in trouble. He was devoted to children and loved to amuse them. He had a most understanding feeling for living animals—for Sally the chimpanzee, and in more recent years for a young gorilla then living in London and taken from time to time for exhibition in the Zoological Gardens. In these Anthropoid apes and in his dog he was quick to recognise the terror aroused by the unexpected and oftentimes by the near presence of man. I especially recall his feeling for the gorilla looking out with a terrified apprehension upon the torrent of humanity in a London street. When it has been doubted whether animals possess reason as apart from intelligence, whether any animal can ever in thought ask 'why', he has spoken of the wonder "What is the meaning of all this?" which he felt might be recognised in the pensive expression of Sally.

A side of Lankester's character, sometimes insufficiently appreciated, was his essential and abiding boyishness. "I hear you're a very quarrelsome man"—the words with which he was received by Archbishop Temple when he called as a candidate for the directorship of the Natural History Museum—gave him just the opening he could make the most of, the one he would have chosen for himself. Like a boy he loved fun, and he loved fighting, but was always ready to make friends when the fight was over, a readiness not always exhibited by the other side. Lankester, if shewn to be wrong by a foe worthy of his steel, would express regret and apologise in the midst of the encounter. Once, when we were playing on the long since abandoned Hincksey golf-links and had reached one of the greens below the oak, far-famed as the "signal-elm" of Matthew Arnold's lovely poem, a ball, struck by a player far behind us, came bounding down the hill. Lankester watched its approach with rising wrath, and when it crossed our green and finally came to rest on the opposite

side, he stamped it into the ground. The player, after inspecting his buried ball, followed us to the next tee, and first explaining that he had struck from an impossible position and had shouted his apologies, proceeded to attack Lankester in the most violent terms of which he was capable, and his capacity was of a high order. Lankester at once said "I was wrong: I apologise". "I was wrong too: I ought not to have used such language", the other replied, and they shook hands. Lankester had mistakenly assumed that we had been followed by a heedless player who knew nothing and cared nothing for the rules of the game. The incident brings to light a weakness which increased with increasing age—a tendency to attach too much importance to small things, and especially to technical details of procedure or terminology which seemed to exercise an irresistible attraction for him. But this is a small failing in a very great man who has left a deep and enduring mark upon zoological science and upon the intellectual life of the Darwinian epoch. EDWARD B. POULTON.

The strong personality and penetrating mind of Ray Lankester must have exercised a strong influence on the lives of many of his old pupils, and the news of his death will be received by them with feelings of deep regret and grateful remembrance. As a student who attended the first course of lectures he gave at University College, London, I can well recall the impression he made upon me then. His personal appearance was not what I expected. It seemed to me almost incredible that a man who had gained such a great reputation should be so young, strong, healthy, and well dressed, and when he began to speak, his resonant voice and his clear and decisive sentences seemed to penetrate into my mind as no other teacher's had ever done before. In those days the students were more rowdy in class than they are now, and as a rule a great deal of time was wasted in partially successful attempts to maintain order. It struck me therefore as strange that in Lankester's classes there was never any disturbance: the men felt his power, they became interested in what he had to say, and they were satisfied to remain quiet. We all felt that the lectures given by him were not of the ordinary text-book stuff; their substance seemed to come direct from the zoological workshops of the world, and was illuminated by many brilliant generalisations and pungent criticisms.

Practical work in zoology in those days was almost a new thing: there were no books to help us, and the appliances provided were for the most part inadequate; but, as it was impossible at first to get demonstrators, we had the great advantage of the personal guidance and supervision of the professor himself, and it was in the practical class that some of us formed that deep reverence and affection for our master which has lasted throughout our lives. He hated carelessness or sloth, and at times his anger was terrible, but he freely gave his great skill in manipulation, his sympathy, and his wise advice to the earnest student.

When, in later years, we came into closer touch with Lankester as advanced students or as demonstrators, we marvelled at the rapidity with which he wrote and illustrated his original contributions to zoological science in several of its branches, and at his wide and accurate knowledge of the literature of the subject. It is true that there was far more untrodden ground and a great deal less literature to read in the late 'seventies than there is now; but, looking again at some of the papers written by him at that period, I still wonder at the originality and accuracy of his work.

For the first few years, I cannot remember how many, Lankester used to live in Oxford and come to London two or three days a week to give his lectures; but when the Jodrell endowment of his chair was made, he moved into lodgings in London, and I well remember the keen pleasure it gave me when I was invited to spend an evening with him. On those occasions I often met distinguished men of science of the day, and I never left without feeling that I had gained inspiration and instruction.

Lankester's conversation was not only interesting when it turned on scientific subjects. He had wide and liberal sympathies with all the important events of the day, and always spoke with original and decisive views. He was perhaps at his best when engaged in a campaign against some form of humbug or imposture. I can well remember his account one evening of the séance in which he and Dr. Donkin exposed the trickery of the medium Slade, who was afterwards and in consequence convicted at a police court and sent to prison. Lankester's hatred of imposture seemed to be a kind of religious fervour, and he would act without regard to or fear of the consequences. His public-spirited zeal in these matters naturally led to rancour and abuse from the friends and supporters of those whom he exposed; but if he made some enemies as a consequence, those who knew him best never wavered in the belief that in everything he did he was absolutely sincere.

He had a wide knowledge of the drama and a personal acquaintance with many of the leading actors of the day, and in art he had a cultured taste and an interesting critical faculty. On both these matters he spoke with interest and with authority. At the time when he was at University College he was not apparently specially interested in any kind of outdoor games; his passion for golf developed later. But I was present on one occasion when he and Francis Balfour were engaged in an amusing controversy on the respective merits of rowing and lawn tennis, Lankester, who had rowed in the Downing College boat, supporting rowing and Balfour lawn tennis.

The influence that Lankester had on the development of research in zoology during his tenure of the Jodrell professorship at University College, London, was widespread. As editor of the *Quarterly Journal of Microscopical Science* he was able to encourage good work, but it was principally on account of his wide and liberal sympathies with workers in various fields of research that his advice and help were so eagerly sought. At that time the study of embryology seemed to predominate over any other

branch of research, and most of the younger men were engaged either in working out the development of some animal from the egg or the organogeny of some of the higher forms. As an authority on embryology, there were few men more distinguished than he was; but the older methods of comparative anatomy and systematics appealed to him also, and he was always ready to encourage serious work in any field that seemed to him to help in the solution of the current problems in biology.

I came less into touch with Lankester when he returned to Oxford as Linacre professor, and doubtless others will write with better authority than I can of the subsequent periods of his life, but his interest in the progress of science was maintained to the end, and he never failed to stimulate and encourage those genuinely engaged in research. When I saw him last, only a few weeks before his death, though feeble and in pain, he talked to me for nearly an hour about the fresh-water medusæ, pleading for more research work and for better illustrations of these interesting little jelly-fish.

His old pupils salute at the passing of a great master and cherish the memory of a sincere friend.

SYDNEY J. HICKSON.

Ray Lankester will be remembered as a teacher with unusual gifts, as an original and versatile investigator, and as a leader in scientific thought who performed conspicuous service in advancing the study of morphology. Those who had the privilege of knowing him could not fail to be impressed by his forceful personality, his wide knowledge, and his critical judgment. Those of us who were fortunate enough to be his pupils had a profound admiration for the masterly way in which he handled his subject. His mental attitude, well described in his own words as that thriftless yearning after knowledge, that passionate desire to know the *truth*, which causes the unceasing advance of science, was infectious. In some of us who first attended his lectures with no thought of making a life-study of his subject (I speak from my own experience) he induced the belief that the pursuit of zoology was the object most worth living for. His marked success in exposition is further shown by the valuable articles he contributed to the "Encyclopædia Britannica", for example those on Protozoa and Mollusca. In his later years he published frequent essays, addressed to a wider public and characterised by the same qualities which had made him so successful in a professorial capacity.

Lankester's "Notes on Embryology and Classification", republished separately in 1877 "for the use of students", was of outstanding value as an introduction to the principles of morphology and classification. His insight and success in introducing new nomenclature just where it was most wanted are remarkably illustrated by this essay, in which can be found numbers of terms now in universal use, as for example invagination, blastopore, stomodæum and proctodæum, trochosphere, nephridium, homoplasy, and many others. His essay on "Degeneration", a discourse delivered before the British Association in 1879, is another example of his success in marshalling facts to illustrate a general principle. Among his more special contributions to science his studies of *Apus*, *Limulus*, and *Scorpio* were extraordinarily interesting and suggestive.

Among Lankester's other services his connexion with the *Quarterly Journal of Microscopical Science* deserves particular notice. He became one of the editors of this journal in 1869, and for more than fifty years, during most of which he was the principal editor, he maintained this as one of the foremost zoological journals of the world.

At the meeting held on Mar. 31, 1884, for the inauguration of the Marine Biological Association, Prof. Huxley, then president of the Royal Society, stated that the matter was chiefly in the hands of Prof. Lankester. The important part which this Association has played, not only in the development of our knowledge of British marine zoology, but in the elucidation of general problems in oceanography, has been the result of his action taken at that time and of the interest in its affairs shown by him in his capacity as president of the Association in the years which have followed.

During the second half of the nineteenth century an enormous advance was made in the study of morphology (including embryology) and in the examination of its bearing on the theory of evolution. In this advance Lankester had a notable share. He was not merely the unquestioned leader of British morphologists, but also his influence on the advancement of zoological science was widely felt outside our own islands.

SIDNEY F. HARMER.

Ray Lankester's contribution to the progress of marine biology and fishery research in Great Britain should not be underestimated. When little attention was being paid to either subject, he saw clearly what was required and the lines upon which advance was possible. Taking advantage of the general interest in sea-fisheries aroused by the International Exhibition of 1883, he put forward practical proposals which resulted in the foundation of the Marine Biological Association and the establishment of the Plymouth Laboratory. The influence which he was able to exert in Government circles and in the City of London obtained the financial support required for the commencement of a scheme which he had envisaged on broad and far-seeing lines.

Later developments of the work have been only the unfolding of plans which were laid down by Lankester from the beginning. The original building at Plymouth contained rooms specially fitted for biochemical and for physiological work, and the study of what we now call ecology, to which he had already given the name bionomics, was one of the very first branches of marine research for which provision was made. The difficulties which he encountered and overcame were very great. No one in authority in England at that time had any

conception of the considerable expenditure which is necessary if research work at sea, even in coastal waters, is to be conducted with success and with safety to those engaged in it. It was a source of great gratification to him when, in later years, funds more adequate to the carrying out of his ideas were made available.

No one who ever worked with Lankester could fail to be impressed by the outstanding character of his intellectual ability, the breadth and essential rightness of his outlook, and the value of his judgment on any matter to which he had devoted serious thought. It was only necessary to convince him of the soundness and disinterestedness of a scheme to ensure his help and support in its execution. He never fought for the love of battle, though anything which seemed to him to savour of incompetence or pretence called forth a vigorous response. He never bore malice, and was full of gratitude and kindly feeling to those with whom he co-operated. No man of his generation did more for the advancement of scientific thought and especially for the advancement of biology.

E. J. ALLEN.

News and Views.

HEARTY congratulations are due to Sir Thomas Muir, the veteran mathematician, who celebrates his eighty-fifth birthday on Aug. 25. He has been resident for upwards of forty years in Cape Colony. Muir was born at Stonebyres, Lanark, Scotland, and educated at Wishaw School, graduating at the University of Glasgow. Filling, in an interim, a post as mathematical tutor at St. Andrews, he returned to his old university in 1871, becoming assistant professor of mathematics there; afterwards he was headmaster of the mathematical and scientific departments in Glasgow High School. In 1892 Muir was appointed Superintendent-General of Education in Cape Colony, holding office until 1915, when he received the honour of knighthood in recognition of long and arduous work in new fields of educational effort demanding vision and strength of purpose.

SIR THOMAS has been a prolific author of papers contributed to the Royal Society of Edinburgh, the *Messenger of Mathematics*, and *Philosophical Magazine*, as well as to the publications of the South African Philosophical Society. He was an active promoter of the programme of the British Association on its first and memorable visit to South Africa in 1905. In 1910, Sir Thomas was president of the Cape Town meeting of the South African Association, and delivered an address on "The State's Duty to Science". The Royal Society of Edinburgh has on three occasions awarded him the Keith gold medal for researches into the theory of determinants and allied subjects. Sir Thomas was elected into the Royal Society of London in 1900.

DR. NORMAN DAWSON ROYLE has been awarded the Walter Burfitt Prize of the Royal Society of New South Wales for his contributions to the study of muscular action and his investigations into the problems of muscular paralysis. The prize has been adjudged to him by the Council of the Society for papers published during the years 1926–28. This is the first award of this triennial prize, which is to be given for the papers of highest scientific merit published during the previous three years by a worker in pure or applied science resident in Australia or New Zealand. Dr. Royle has been engaged for nearly fifteen years in research into the manner in which the contractions of muscles within the body are controlled by the nervous system. His discoveries have added a new conception to our knowledge of the type of nervous control of muscular movement. The idea that nervous impulses are conveyed through nerves of the sympathetic system into muscular fibres has attracted world-wide interest. His discovery has thus illuminated that field of physiology, rescued from darkness by the genius of Magendie at the beginning of the nineteenth century, added to the brilliant picture of the mechanism of the regulation of motion by nerves expounded by Claude Bernard, and extended our view of reflex action elaborated with so much detail by Sir Charles Sherrington. Not only have these contributions given to us a better explanation of muscular movement, but also they have formed the basis of new means of treatment which have given a new life to many cripples who had never expected to walk again.

THE problem presented by the buffalo fly (*Lyperosia exigua*) is causing much uneasiness in the northern cattle-raising areas of Australia. The fly no doubt came originally from Java. It is not a pest there, partly because of the existence of natural enemies and partly because the Javanese cattle are much less affected by it than the European breeds of Australia. A few years ago the area of incidence was small, being confined to the immediate neighbourhood of Darwin and the northern coastal region of Western Australia. To-day the fly is found very much farther south, it has entered Queensland on the east, and is spreading rapidly to the west. All the country round Wyndham is heavily infested. Recent reports are that the cattle boats have brought it to Fremantle, but whether it can live so far south remains to be seen. The fly attacks chiefly the flesh at the base of the horn, or any broken portion of the animal's skin. The irritation to which it gives rise prevents the cattle from resting, either by day or by night. The raising of fat cattle for slaughter is rendered almost impossible at certain seasons, and, indeed, it seems possible that this pest may prove to be a main limiting factor in beef production in the northern areas of the Commonwealth. In view of the world position in the beef industry, the situation is disquieting from an Empire point of view.

DIPPING methods are useless in dealing with a winged pest of this type: in any case they are out of the question in areas where a cattle muster is possible only once every year, or perhaps two years. A measure of con-

trol by parasites or predators seems to be the only practical possibility. Dr. Nieschulz, of the Veterinary Institute at Buitenzorg, has already carried out some investigations for the Council for Scientific and Industrial Research, and has found in Java four parasites which may prove to be of use. Two officers of the Council are now continuing this work, which lapsed when Dr. Nieschulz returned to Utrecht last year. At the same time another entomologist is studying the habits and life-history of the fly in the Northern Territory. Among other questions to which answers must be obtained is that of whether or not the fly is carried by native animals and can breed in their dung. An affirmative answer means that the position becomes very serious, since 'buffer areas' cannot then be made effective in preventing spread. The two problems of the striking of sheep by certain species of blowfly and the irritation in cattle by *Lyperosia* are amongst the most serious and difficult which the animal industry in Australia is facing to-day.

THE research scheme of the Institute of Brewing has a record of which any such organisation may be proud. In the first place, the whole of the financial support is provided by the 303 firms of brewers, maltsters, and barley and hop growers constituting its corporate membership, and the satisfactory state of its finances is an indication of the appreciation by an important industry of the value of research. Secondly, as the Memorandum for 1929 shows, the achievements of the scheme are no less creditable and amply justify the trust implied in the provision of such large sums of money. The brewing and allied industries, perhaps more so than many others, have reached their present position largely through accumulations of practical experience, and there are consequently numerous unsolved problems. The advisory sub-committees of the research scheme have therefore had to fling a wide net in order to embrace as many of these as possible. Studies of the breeding, cultivation, storage and evaluation of hops and barley carried out in collaboration with several agricultural research stations have already yielded numerous valuable results, references to which have appeared from time to time in our columns, while the work of the late H. T. Brown on the action on yeast of non-assimilable wort proteins is also being continued. In addition, the much-criticised problem of hydrogen ion concentration has been studied intensively, and a report issued on the practical advantages of the adjustment of *p*H values in the brewery.

MUSEUMS need not be mere storehouses of inanimate objects; a thoughtful staff can do much to build around the specimens in their care the reflection of a human setting, thus enabling the significance of the exhibits to be appreciated by an ever-widening circle of interested visitors. An example of such treatment is afforded by the recently issued handbook of the collections in the Science Museum, South Kensington, illustrating industrial chemistry (London: H.M. Stationery Office. Price 1*s.* net). This volume, although containing a descriptive catalogue of the collections, differs from previous catalogues in that considerably more than half the book is devoted to illustration of the development which has taken place in that branch of science. Hence there is provided a background of human interest against which the exhibits themselves may be studied, and some idea of the course of evolution of a great modern industry may be gained. The museum authorities, and in particular the compiler, Mr. A. Barclay, are to be congratulated on producing a handbook which is not unworthy of a permanent place in any library of historical chemistry. The scene surveyed is, of course, so wide in its extent and so varied in its aspects that even the principal portions of it can receive but brief treatment and incomplete illustration. That such should inevitably be the case detracts in no way from the advantage of the method of presentation adopted or from the interest of the exhibits—nearly one hundred—which are to be found in Gallery LXVI. of the Science Museum.

THE Handbook deals with the origin and early history of industrial chemistry; technical chemistry in the Middle Ages; industrial chemistry in recent times; mineral acids, alkalis, and allied products; coal tar distillation products; explosives; artificial dyes; artificial silk; fermentation processes; mineral oil products; and one or two other examples of chemical technology. The catalogue differentiates between inorganic and organic processes, and gives a technical account of the corresponding exhibits. There are described, for example, models of various types of plant for the manufacture of sulphuric acid, including the first type of plant to have sulphur burners separate from the leaden chamber. A model of a Cheshire salt plant illustrates the manufacture of blocks of common salt from brine by evaporation in open pans, as carried on in Cheshire at the present day, whilst other exhibits represent the cement kiln erected by William Aspdin, son of the inventor of Portland cement, and a modern plant including the rotary kiln. Yet other models depict processes for the production of black powder, gun-cotton, nitroglycerin, and trinitrotoluene. Early specimens of artificial silk made by the cuprammonium, nitrocellulose, and viscose processes, and samples illustrating the acetate process are included in the collection. Stills for the preparation of whisky, for the manufacture of alcohol, and for the refining of mineral oils are shown, together with oil shale retorts, and certain examples of general plant. The handbook is well illustrated by photographs of actual operations as well as of certain of the museum exhibits.

THE scheme for the electricity supply of the north-east of England has now been published. It covers an area of about 5000 square miles, and includes the counties of Northumberland, Durham, and part of the North Riding of Yorkshire. This area is almost the same as that covered by the Newcastle-on-Tyne electricity company and the companies associated with it. The population in the area is about two and a half millions, and notwithstanding the depression of the shipbuilding, coal-mining, and iron and steel industries, some important industrial

developments have taken place there during recent years. At Billingham there is one of the most important plants in the world for the production of synthetic nitrates. The Newcastle company at Dunston has started low temperature carbonisation, and several very flourishing companies are manufacturing electrical plant and switchgear. Under the new proposals, six of the existing stations have been selected and will be operated by the Central Electricity Board. Four of these will be interconnected with the main transmission line at 132,000 volts. An extension from the North Tees station links up through Scarborough with the mid-east England scheme. Secondary lines operating at 33,000 volts will carry the system to Northallerton and Thirsk, where it will again join the mid-east scheme in the North Riding. It has been estimated that this system of interconnexion will bring 80,000 kilowatts of plant which at present is kept as a reserve into active operation. This means that more than a million pounds of capital now lying idle will become revenue-earning The Government scheme has standardised the frequency of fifty, and unfortunately the frequency in this area is forty. No further 40-cycle plant will be purchased, and gradually the whole system will be converted to the standard frequency.

IT would appear that the great Shyok ice dam has burst at last. Last year at this time (NATURE, Aug. 25, p. 285) it was reported that the dam had been broken, but it proved to be a false alarm. This time the magnitude of the Indus flood reported by correspondents of the *Times* at Peshawar and Lahore leaves little doubt that the huge artificial lake in the Karakoram Mountains caused by the Little Khumdan glacier has burst. It is stated that the flood reached its maximum at Attock on Aug. 19, the Indus being more than 50 ft. above normal and only $3\frac{1}{4}$ ft. lower than the previous highest flood, and is now subsiding. The Attock railway bridge apparently has not been damaged; it has been constructed specially to withstand such floods. Extensive precautions have been taken lower down the Indus at Sukkur and at Karachi. Owing presumably to the swift warning given of the approach of the floods, there has been little loss of life.

THE medal of the Institution of Mining Engineers has been awarded to Mr. George S. Rice, chief mining engineer of the United States Bureau of Mines, Washington, "in recognition of his eminence in all matters relating to the safe working of coalmines and the well-being of mine workers, with special reference to the practical application of scientific knowledge".

WE learn from Kew Observatory that a message broadcast from Arlington gives some details of an earthquake registered at American stations at about 20 hr. G.M.T. on Aug. 15. The co-ordinates of the epicentre are given as 4° N., 82° W., that is, under the Pacific Ocean near Central America. The shock was recorded at Kew as a small disturbance at a distance of about 9000 km. Small earthquakes were also recorded at Kew Observatory on Aug. 17 (preliminary tremors arriving at 23 hr. 53 min. 11 sec. G.M.T.) and on Aug. 19, at 2 hr. 56 min. 1 sec. G.M.T. Both shocks appear to have originated at an epicentre 5800 miles away, probably near Central America.

THE National Radium Trust, which is constituted as follows: Lord Parmoor (chairman), Mr. Arthur Greenwood, Mr. W. Adamson, Sir Ernest Rutherford, Sir John Rose Bradford, Lord Moynihan, Lord Dawson, Lord Mackenzie, Prof. A. H. Burgess, and Viscount Lee, has made preliminary arrangements in connexion with the purchase of radium, with the view of placing it as soon as practicable at the disposal of the expert body, the Radium Commission. The Commission has now been set up in accordance with the provisions of the Royal Charter, and is composed as follows: Viscount Lee (chairman); Lieut.-Col. Smallman, Medical Officer of the Ministry of Health; Mr. H. L. F. Fraser, Assistant Secretary of the Department of Health for Scotland; Prof. Sidney Russ, Professor of Physics, Middlesex Hospital Medical School; Dr. G. W. C. Kaye, Superintendent of the Physics Department of the National Physical Laboratory; Dr. J. M. W. Morison, lecturer in radiology, University of Edinburgh; Prof. G. E. Gask, professor of surgery, University of London; Mr. W. Ernest Miles, surgeon to the Cancer Hospital, Brompton; Dr. Comyns Berkeley, gynæcological surgeon to the Middlesex Hospital; Dr. Carlton Oldfield, professor of gynæcology, University of Leeds, and Prof. A. J. Hall, professor of medicine, University of Sheffield.

THE "Statistical Report of the Health of the Navy for the Year 1927" has recently been issued (London: H.M. Stationery Office. 5*s*. net). With a total force of 93,230, both the incidence of disease and the invaliding ratio show decreases compared with the previous five years' average. Only 18 cases of typhoid and paratyphoid fevers, and 5 cases of Mediterranean fever occurred. Malaria with 332 cases shows a fractional decrease. Of influenza there were 2562 cases, though with only one death. With 6239 cases, venereal diseases show a decrease compared with the five years' average and with 1926. A short summary is included of research work carried out at the Royal Naval Medical School, Greenwich.

MESSRS. FRANCIS EDWARDS, LTD., 83 High Street, Marylebone, W.1, have recently circulated a most interesting catalogue (New Series, No. 3) of atlases and maps of all parts of the world, ranging from the fifteenth century to the present day. The catalogue is beautifully printed and contains a reproduction, in colour, of Blaeu's View of Flushing, 1649, from one of the works listed; also several maps in black and white and a number of useful bibliographic notes which should prove of interest to geographers. The same firm has also issued a catalogue (No. 518) of nearly 300 works (books, maps, views, early parliamentary papers and newspapers) relating to New Zealand.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in the Department of Pathology of the University of

Liverpool—The Registrar, The University, Liverpool (Sept. 2). A full-time lecturer in engineering at the Sunderland Technical College—The Chief Education Officer, Education Offices, 15 John Street, Sunderland (Sept. 9). A cotton research botanist under the Indian Central Cotton Committee for research work in the Bombay Presidency—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Sept. 21). A senior lecturer in economic history in the University of Melbourne—The Agent-General for Victoria, Victoria House, Melbourne Place, Strand, W.C.2 (Sept. 30). A senior lecturer in economics in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (Oct. 1). A lecturer in physics in the University of Reading—The Registrar, The University, Reading. A full-time assistant in electrical engineering at the Technical College, Wolverton — The Principal, The Technical College, Wolverton, Bucks. A handicraft teacher under the Warwickshire Education Committee—The Director of Education, County Education Office, Warwick. A draughtsman for technical publications work at the R.A.E.—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (quoting A. 363). An assistant metallurgical chemist at the Sheffield Metallurgical Laboratories—The Metallurgical Laboratories, 1 Staniforth Road, Sheffield. A technical instructor for the posts and telegraphs department of the Government of Nigeria — The Crown Agents for the Colonies, 4 Millbank, S.W.1.

Our Astronomical Column.

Two New Comets.—After a blank interval of some six months, two new comets were discovered at the beginning of August. 1929 *b* was found by Prof. G. Neujmin at Simeis Observatory, Crimea, on Aug. 2. Prof. G. Neujmin had previously discovered two comets: 1913 III., period 18 years; 1916 II., period 5·5 years. The second was seen again at the return in 1927. The following observations are from *U.A.I. Circulars* 224 and 225:

Date 1929.	R.A. 1929·0.	S. Decl. 1929·0.	Observer.	Mag.
Aug. 2·9547 U.T.	21h 16m 2·0s	12° 45′ 48″	G. Neujmin	13·5
4·9693	21 15 19·4	12 55 9	M. Wolf	14·5
6·9318	21 14 34·4	13 4 32	M. Wolf	—

The second and third positions are from photographs at Königstuhl. *Circular* 226 gives the following position and motion of an object observed at Lick Observatory by Messrs. Krieger and Bobrovnikoff:

Date 1929.	R.A. 1929·0.	S. Decl. 1929·0.	Mag.
Aug. 12·3505 U.T.	21h 13m 18·6s	13° 37′ 51″	15·0

Daily motion – 50s, S. 8′.

This may be the comet, but the motion in R.A. is rather more rapid than that suggested by the first three positions. Prof. M. Wolf at first gave the following position for Aug. 4:

Date 1929.	R.A. 1929·0.	S. Decl. 1929·0.	Mag.
Aug. 4·9478 U.T.	21h 14m 27·1s	12° 28′ 24″	15·0

Daily motion – 52s, S. 1′.

Afterwards he announced that this object was a minor planet, not the comet.

A later message states that a computation of the orbit by Strömgren gives the date of perihelion as July 3, distance at perihelion 2 units, period 12 years.

The other new comet was found on Aug. 1 by Mr. A. F. J. Forbes, of Rosebank, Cape Town. He will be remembered as the discoverer of comet Pons-Coggia-Winnecke-Forbes in November last.

The following position is from *U.A.I. Circular* 224:

Date 1929.	R.A.	S. Decl.	Motion.
Aug. 3·750 U.T.	20h 0m 52s	30° 26′	North-West.

A telegram on Aug. 8 threw some doubt on the direction of motion, and apparently on the reality of the comet, but *Circular* 226 states that the latter is confirmed, and gives the magnitude as 11. No further observations have come to hand.

The August Perseids of 1929.—Mr. W. F. Denning writes: "The shower of meteors occurred this year when the moon was absent from the morning sky and this circumstance favoured observers. Aug. 10 was cloudy except in the early part of the night and little could be seen. Aug. 11 proved mostly clear except for about two hours between 11h and 1h G.M.T. in the early morning of Aug. 12. Meteors were not very numerous, but many of them were of conspicuous brilliancy; in fact what they lacked in numbers they compensated for in their lustrous and attractive aspects. More than thirty were estimated to equal the apparent magnitude of either Jupiter or Venus, and their long paths and vivid streaks formed striking features. Three observers at Bristol observed about 320 meteors during the night following Aug. 11, but the watch was not continuous and clouds partially interfered during two hours of the time.

"Aug. 12 came in clear, but meteors gave evidence of a decline in numbers and particularly after 11 P.M. In fact, they became so scarce at 0h 45m A.M. on Aug 13 that observations were discontinued. In past years the night of Aug. 12 has often proved very prolific in meteors, but the experience this year was very different."

Future of the Moon.—Dr. H. Jeffreys contributes a third article to the *Realist* for August on the earth-moon system. He notes that the strength of the hypothesis of Sir George Darwin on the birth of the moon by tidal disruption of the earth lies in the coincidence that the initial rate of rotation of the earth (about 4 hours) is found in two ways: (1) from the moment of momentum of the earth-moon system; (2) from the necessary period for tidal magnification through resonance; and these give accordant results. He makes more definite estimations of time than Darwin ventured upon; he gives 4000 million years for the past duration of the system, and states that it will take a period ten or a hundred times as long for the moon to reach its maximum distance. Since the return of the moon will be much slower than its recession, the estimate that in a billion years from now the oceans will be frozen even at the equator seems to put the further development of the process outside practical politics. Dr. Jeffreys notes two points of interest: Roche's limit ceases to apply for bodies that are only a few miles in diameter; thus Phobos could approach close to the surface of Mars without disintegrating. This point was overlooked by Sir George Darwin, who suggested that its disintegration was imminent, owing to its proximity to Roche's limit. The other point is that the moon's interior is likely to contain a considerable proportion of radioactive elements, which have retarded its cooling. Hence a period of mountain formation through shrinkage may still be in store for the moon.

Research Items.

Sociology of the Californian Aborigines.—Volume 26 of the *University of California Publications in American Archæology and Ethnology* is an extensive study of aboriginal society in southern California by Dr. William D. Strong, for which the materials were gathered in 1924–25 from the Serrano, Cahuilla, Cupeño, and Luiseño Indians, now living on reservations in Riverside and San Diego. These peoples retained their old culture much later than the peoples of the coast, yet the work of the ethnologist is very much that of the social palæontologist and must therefore be largely reconstructive. Complete understanding is impossible. No trace of tribal organisation appears. The social unit is the local autonomous group of male lineage; but important social and religious functions are associated with group priest, ceremonial house, and sacred bundle or fetish, often welding several collateral lineages into one group—an added bond to that of kinship. A dichotomous organisation of society more extended than the simple male lineage is indicated by such concepts as exogamy, reciprocity, a dual conception of the universe especially as regards animals, the use of dotted and striped facial designs to distinguish the moieties and a similar use of red and black paints. This dichotomy was superimposed on the localised lineage organisation. Hence the designation of lineage and not moiety characterises the classification of relations among all groups. There was a comparatively early intrusion of cultural traits, tentatively assigned to the Pueblo culture, in the coastal region. In southern Californian ceremonialism, female puberty rites and ceremonies to drive away the spirits of the dead underlie all other cult activities. On this widespread substratum have arisen the elaborate cult activities containing many Puebloan activities; but the old basic ideas persisted and are the more important sources of ceremonial motivation in south California.

Anatomy of Freshwater Mussels of the District of Columbia.—Five genera of Unionidæ are native to the District of Columbia, U.S.A., and anatomical descriptions of five species are given by Lucy Reardon (*Proc. U.S. Nat. Mus.*, vol. 75, art. 11). Two of these belong to the genus *Lampsilis*, one to *Anodonta*, and two to *Elliptio*. Only in the first species dealt with is the complete anatomy set forth; in the rest the details are successively curtailed and no comparisons are made. The author seems to have relied on her series of diagrammatic figures, which, though very clearly drawn, have been unnecessarily reduced in size with corresponding loss of value.

Polyvitelliny in Pond Snails.—The occurrence of more than one vitellus, or embryo, in a single egg of some of the fresh-water pulmonates has never been satisfactorily explained. E. D. and R. M. Crabb have made a study of the subject in *Limnæa* and *Physa* (*Biol. Bull.*, vol. 53) and find that polyvitelline eggs may be expected to occur among normal eggs. They found that the included vitelli vary in number from two to as many in one case as forty-six, and that true twins do not occur. It appears probable that the ova passing down the filiform part of the hermaphrodite duct where it bends round the gizzard are inhibited to such an extent by the actively contracting gizzard that several ova accumulate in the enlarged part of the duct, and that during a period of reduced activity of the gizzard all pass into the convoluted uterus at one time and become enveloped by the albumen and the egg membrane which would normally cover a single vitellus.

The Ganglion Cells of Earthworms.—F. Ogawa (*Sci. Rep. Tôhoku Imp. Univ.*, Ser. 4, vol. 3, No. 4, Fasc. 2) has investigated the number of ganglion cells in the corresponding ventral ganglia of three species of earthworms of the genus *Perichæta* which live together and have similar body sizes. The ganglion of the 30th segment was first observed, this being selected because of the simple arrangement of organs in that region in all three species, and the average number of ganglion cells was found to be 1208, 1171, and 1141 respectively. In the ganglion of the 18th segment of specimens of *Perichæta hilgendorfi* and *P. vittata* which did not possess a prostate gland, the number of ganglion cells was 1519 and 1532 respectively, but in the ganglion of the 18th segment of *P. communissima*, which possessed prostates, the number of cells was found to be 4050. A variety of *P. vittata* with paired prostate gland in the 18th segment was found to have 3433 ganglion cells in the 18th ganglion, hence the presence of the gland causes the ganglion cells to increase in number. But this increase in the number of cells produces only a slight increase in the volume of the ganglion, the cells being more crowded.

Reproduction in Sea Anemones.—T. A. Stephenson (*Jour. Mar. Biol. Assoc.*, vol. 16, No. 1, May 1929) has studied, with regard to their reproductive processes, eight species of British sea anemones, namely, *Sagartia elegans, lacerata, sphyrodeta, troglodytes*, and *anguicoma, Cereus pedunculatus* and *Diadumene cincta* and *luciæ*. Deposition of ova may co-exist with any other method of reproduction, except perhaps in certain viviparous forms. Apart from this, one method only prevails in any one of the selected species. Longitudinal fission occurs in *S. sphyrodeta* and *D. luciæ*, laceration by tearing in *S. elegans* and *D. cincta*, laceration by constriction in *S. lacerata*, while *S. troglodytes* and *C. pedunculatus* are viviparous. In *S. anguicoma* neither viviparity nor asexual reproduction occurs. The viviparous forms studied do not reproduce asexually, nor are those which reproduce asexually viviparous. Pieces were cut off from the margin of the base (artificial laceration) of four of the above species. In *S. elegans*, which lacerates naturally, nearly 100 per cent of the pieces regenerate easily, and the same is true of *S. lacerata*. In *S. troglodytes*, which does not lacerate naturally, only two out of seventy-six pieces regenerated fully, but in *S. anguicoma* the percentage was much higher. The author refers to the sixteen specimens living in Edinburgh of *C. pedunculatus*, the age of which is at least seventy years, and records that one of these aged examples in 123 days in 1925 produced 102 young.

Species of *Phytophthora* in Malaya.—The economic importance of plant diseases caused by *Phytophthora* spp. is considerable, particularly in tropical regions. From this point of view, A. Thompson (*Malayan Agric. Jour.* **17**, 53, 100; 1929) has recently studied diseases of rubber, Roselle fibre, and betel vine plants from which a number of strains of *Phytophthora* have been isolated and described. Those from rubber are responsible for the diseases known as black stripe, patch canker, and pod-rot. Western Malaya is, however, comparatively immune from some *Phytophthora* diseases known elsewhere, apparently owing to the drier conditions in the early part of the day.

A Polyploid Species.—*Prunus laurocerasus* is shown by Meurman (*Jour. of Genetics*, vol. 21, No. 1) to have a remarkably high chromosome number, 170-180 chromosomes being counted in a plant at Kew. This number probably represents twenty-two times the basal number eight. The chromosome segregation is irregular in pollen formation, so that gametes with various numbers are formed. The chromosomes are

usually in higher groups than pairs, occurring in the reduction division in threes, fours, fives, sixes, and sevens. Probably still larger groups of homologous chromosomes are associated in some cases, as well as certain univalents which may split in the first reduction division. The possible origin of this highly polyploid condition is discussed.

Petal-colour and Hydrogen Ion Concentration.—It is commonly stated that anthocyanins are red in acid and blue in alkaline or neutral media, but Messrs. Buxton and Darbishire (*Jour. of Genetics*, vol. 21, No. 1) found that the petals of some red-flowered plants will not turn blue at all in passing from acid to alkali. A series of tests were then made on the flowers of various common plants, by pounding up the petals and placing them in media ranging from *p*H 3 to *p*H 11. Usually the blue flowers run through red, pink, and violet to blue at the neutral point, then becoming greenish and finally yellowish, with increasing *p*H, owing to the presence of flavones. This was true of *Aconitum*, *Aquilegia*, *Campanula*, *Delphinium*, *Lathyrus*, *Linum*, *Primula*, *Salvia*, and others. In clear red flowers, such as *Begonia*, *Dahlia*, poppy, rose, and *Tropœolum*, on the other hand, the colour series with increasing hydrogen ion concentration runs from vermilion to pink and purple or brownish tints (the latter due to flavones) without ever becoming blue. *Salvia splendens* belongs to the latter series, while the blue *S. patens* remains blue from *p*H 4 to *p*H 8. Flowers with various intermediate shades of purple, magenta, or pink contain in their petals mixtures of the blue and red anthocyanins in varying proportions. The cell sap of a red or purple flower is therefore not necessarily more acid than that of a blue flower, and a red mutation could arise from a blue flower without any change in the *p*H of the cell sap.

Mineral Wealth of the Black Hills of Dakota.—In the Black Hills of Dakota an unusual variety of minerals are to be found, many of them of great economic value. During the fifty years of their settlement, this area has produced one-eightieth of all the gold known to have been mined in the history of the world, and it still boasts the largest low-grade gold mine now working. Here, too, occurs the greatest lithia-producing mine. Mica and felspar are mined, together with rarer minerals such as columbite, tantalite, beryl, tinstone, and wolfram. J. P. Connolly and C. C. O'Harra have published a comprehensive and up-to-date account of the geology and mineral wealth of the Black Hills in *Bull.* 16 of the South Dakota School of Mines (May 1929, pp. 418+ 64 plates). The bulletin contains a valuable study of pegmatites and of the celebrated Homestake Mine, as well as a convenient summary of the history and economics of the region. It should not be overlooked by mining geologists or mineralogists.

Neogene Shells from Japan.—A further contribution from Prof. Matajiro Yokoyama (*Jour. Fac. Sci. Imp. Univ. Tokio*, Sect. 2, vol. 2) describes some Neogene shells from certain provinces of Chūgoku, the south-western extremity of the Main Island. Those from the province of Iwami are probably Pliocene, but whether the others are Pliocene or Miocene it is at present difficult to say. Twenty-nine species in all are recorded, and of these four new species are described as well as a form which is almost indistinguishable, although smaller, from the *Arca camulœnsis* Osmont, from the Fernando formation of California.

Japanese Polymorphinidæ.—Dr. J. A. Cushman and Prof. Y. Ozawa in two consecutive papers describe some species of the Foraminiferal family Polymorphinidæ found in the younger Tertiary formations of Japan, and give a revision of the family and its classification (*Japan. Jour. Geol. and Geog.*, vol. 6). The systematic paper abounds in new genera and species all carefully illustrated with clear figures. The classification of the family, far from being a simple problem, proves a complex one. The most primitive structure is met with in *Guttulina*; thence two main series are developed, one typically with the chambers more or less globular, the other typically with the chambers elongate. Further subdivisions follow dependent on the arrangement of the chambers, whether sigmoidal, biserial, or uniserial, as set forth in a table.

Chart of the Pacific.—The June issue of *Terrestrial Magnetism and Atmospheric Electricity* contains a summary by Commander J. P. Ault of the results obtained by the United States survey ship *Carnegie* during her voyage from Callao on the coast of Peru to Tahiti in the Society Islands during February and March of the present year. The depth soundings show the bottom to be very irregular, with a ridge 2000 metres above the general contour between Amanu and Hikuera Islands of the Tuamotu group, and a new deep, which has been named the Bauer deep, in Lat. 15° S., Long. 98° W. The compass deviation averages 10° E., the magnetic dip varies from zero off the coast of Peru to 30° S. near the Society Islands, and the horizontal component of the magnetic force from 0·30 to 0·33. There are five or six regions in which the British, German, and American charts show deviations of the compass which differ by half a degree or more from the *Carnegie* values.

New Model Microscope.—Messrs. C. Baker (244 High Holborn, W.C.1) have submitted for inspection an example of their B.L.M. microscope stand, which is a new model and embodies novel features. The limb is of rigid construction and carries a large body with rack-and-pinion coarse adjustment. A draw tube is provided, which may be graduated and have a rack-and-pinion movement fitted if desired. The fine adjustment is operated by milled heads on either side of the limb, is smooth and sensitive in action, and stops definitely at the end of the run. The instrument is quite stable in the horizontal position. The square stage, secured to the rigid bracket by screws and dowl pins, but easily removable so that other types may be substituted, measures $4\frac{1}{2}$ in. × $4\frac{1}{2}$ in., and has a clip for holding the slide which is moved by milled heads and has an amplitude of 70 mm. in the horizontal, and 30 mm. in the vertical, direction. The slide-clip is detachable in a moment by a very simple device, leaving the stage free and devoid of projections. The substage condenser is mounted on the limb, which thus forms practically an optical bench for alignment of the whole optical system, but can be swung out by pinching a spring and sliding downwards. The condenser, provided with centring screws, is held in its fitting by a thumb-screw, and so is easily removable; focusing is by rack and pinion, or in the cheapest model by a friction slide. The stand is exceptionally strong, rigid, and stable, and we can recommend the instrument as a thoroughly efficient one at a moderate price, for an outfit suitable for bacteriological work with rack-and-pinion focusing sub-stage with Abbe condenser, 2 eyepieces, and $\frac{2}{3}$ in., $\frac{1}{6}$ in., and $\frac{1}{12}$ in. oil immersion (N.A. 1.3), objectives and triple nose-piece, costs only £31 10*s*. Stands of varying elaboration and price are listed.

The 'Fine Structure' Constant.—The issue of *Die Naturwissenschaften* for June 28 contains an article by Prof. A. Sommerfeld, in which he discusses inci-

dentally the question of the numerical value of the atomic constant α ($2\pi e^2/hc$). Prof. Sommerfeld attaches importance to the neat and satisfactory type of argument by means of which Prof. Eddington has indicated that $1/\alpha$ should have a value of 136, and points out in this connexion that it has been demonstrated repeatedly in the last twenty years that the most complete solution of a problem mathematically is often the one found in practice. Apart from this, however, he mentions that some recent American and Swedish measurements of X-ray wave-lengths with artificial gratings seem to show that Avogadro's number N should be changed to $5{\cdot}985 \times 10^{23}$, and hence, by combination of N with the electrochemical equivalent, the electronic charge e should be raised from $4{\cdot}77 \times 10^{-10}$ e.s.u., Millikan's value, to $4{\cdot}835 \times 10^{-10}$ e.s.u. $1/\alpha$ then becomes 135·9, which is almost identical with Eddington's number. It has to be remembered, nevertheless, that Prof. Millikan's value for e is based upon experiments the precision of which has never been seriously challenged, and that there is as yet no obvious internal evidence why it should be in error to the extent of more than one per cent. A very recent discussion of the X-ray data by J. A. Bearden in the June number of the *Proceedings of the National Academy of Sciences* (*U.S.A.*) shows that the value of $1/\alpha$ is more probably 136·6.

Synthesis of Cane Sugar.—Some doubt having been thrown on the synthesis of cane sugar recently effected by Pictet and Vogel, these authors have given in the June issue of the *Berichte* of the German Chemical Society very detailed experimental directions for the synthesis. It is clear that extraordinary precautions have to be taken to obtain successful results, and the failure of other experimenters, in the absence of these details, could readily be expected. It is necessary to follow precisely a definite method in each of the stages of the synthesis, involving the preparation of the γ-tetra-acetyl fructose, the condensation of the tetra-acetate of glucose and of the γ-fructose, the isolation of the octoacetate of cane sugar, and the saponification of the latter. The publication of these details, which were withheld in the first publication, will enable other chemists to repeat the work with more hope of success, and the reality of this important synthesis will no doubt be confirmed.

Action of Ammonia on Phosphorus Pentoxide.—In 1894, Baker found that dry ammonia was not absorbed by phosphorus pentoxide, and other experimenters have recently found that although a slight reaction occurs, at first, there is no further decrease in volume of the gas after forty-eight hours. In the July number of the *Journal of the American Chemical Society*, Harris and Wooster describe some careful experiments in which they show that there is really a very appreciable reaction between purified phosphorus pentoxide and ammonia gas prepared from the liquid dried over sodium and then fractionated. Although the reaction ceased before the pentoxide was saturated with ammonia, this was not due to cessation of the absorption on account of dryness of the gas, since absorption began again when a fresh surface of pentoxide was exposed. Previous results which seemed to indicate that no reaction took place are explained by the formation of a protective film over the pentoxide, a possibility which does not seem to have been reported by previous workers, whose results may have been influenced by it.

Water-cooled Furnace Walls.—The reduction of the number of all the electric power stations in Great Britain and the consequent increase in their size, and also the urgent necessity of obtaining the highest possible efficiency from the plant has led to some notable changes in boiler plant design. Higher and higher furnace temperatures are called for and the use of pre-heated air has become standard practice. The high temperatures make furnace repairs frequently necessary, and consequently lead to frequent stoppage of the boiler plant. This leads to an increased maintenance account and a direct loss of interest on capital. In a circular issued by Messrs. Babcock and Wilcox, Ltd., we learn that these troubles can be practically eliminated by using Bailey water-cooled furnace walls. These walls can be applied to all kinds of furnaces, whether used with stokers, pulverised coal firing, or oil firing. They issue two pamphlets, "Walls for Boiler Furnaces" and "Modern Boiler Plant Furnaces", which describe the advantages of the new furnace walls. This method, which cools all of the furnace walls to a moderate temperature, sounds better than having some part of the walls completely cooled by bare tubes, while other parts are of the usual brick construction.

Stiffness of Crankshafts.—A study of the rigidity of crankshafts is of importance to designers of marine engines, motor-car engines, and of aeroplane engines, and various investigations have been made with the view of evolving methods for calculating the stiffness of such shafts. One such investigation is the subject of *Report* No. 1201, by the Aeronautical Research Committee of the Air Ministry, entitled "On the Stiffness of Crankshafts". The author is Mr. H. Constant, and the tests made were carried out at the University of Cambridge and at the Royal Aircraft Establishment. The torsional resonance speed of an engine depends on the magnitude and distribution of its rotating and reciprocating masses and upon the effective torsional stiffness of its shaft, but this report is concerned only with the questions of stiffness involved. A number of crankshafts were subjected to static tortional tests out of bearings, and also in their crank cases, and from these a ratio of stiffness under the two conditions obtained. The conditions affecting this stiffening ratio were then investigated and a formula in terms of crankshaft dimensions evolved. A consideration of these results led finally to the application of a stiffness formula to the estimation of resonance speeds.

Fatigue Testing Machine.—A new high-speed fatigue testing machine is described by Mr. H. S. Rowell in *Engineering* for July 26. The primary object in designing the machine was the endurance testing of the plates of laminated springs such as are used in motor vehicles, while some of the considerations governing the design were: cheapness of construction, high speed of operation, ease of preparation of specimens, a considerable length of specimen to be under test, a wide range of stresses to be feasible. The ingenious way in which these objects have been attained is clearly shown by the description. Two springs are tested at the same time, each spring being held at four points by buckles of simple design with set screws. The two inner buckles are fixed, but the two outer ones, at the extremities of the test piece, are vibrated up and down by links connected to a gudgeon rod driven from a crank shaft. The total throw of the gudgeon rod is about $\frac{5}{8}$ in. The stress range is governed solely by the position of the buckles on the test piece and the throw of the gudgeon bar. Constructed of parts which are easily procurable, the machine is driven by an electric motor, while the balance is such that the need for foundations is eliminated. Three machines are at present in use having cranks of 0·25 in., 0·3125 in., and 0·375 in. radii respectively.

The Third British Empire Forestry Conference, 1928.[1]

THE third British Empire Forestry Conference was held in Australia and New Zealand last year, and the Summary Report, Resolutions, etc., of the Conference have now been published.

The Conference assembled at Perth, West Australia, under the chairmanship of Lord Clinton, delegates from the Forest Services of the Empire and trade representatives being present. A procedure similar to that followed at the conferences of 1920 (Great Britain) and 1923 (Canada) was adopted. The itinerary included the six States of the Commonwealth and the North and South Islands of New Zealand. The Report gives evidence that a whole-hearted attempt was made to grapple with some of the great difficulties which face forestry in the British Empire, and indicates a fuller appreciation of those difficulties than was perhaps possible in 1920. This is exemplified by the address which opened the discussion on forest technique.

This address commenced with the statement, which it is of the first importance that the Empire should thoroughly appreciate, that there is nothing mysterious in forest management, the principles of which differ in no radical way from those of a business or a farm. Commencing with a simple arrangement sufficient during the early stages of forest development, management became more elaborate with the increasing technique of operations and the increasing value of forest products, now becoming marketable. The preliminary work involved surveys and stock-taking, followed by a regulation of the yield to prevent the most common danger to existing forests, overcutting. The aeroplane was brought in to assist survey work, and its wider application was recommended under certain conditions.

Special reference was made to the effect on the permanency of forest industries by the regulation of the yield. Sylviculture, which is the foundation of all true forest management, was then briefly dealt with, the various systems were discussed, and the modifications or adaptations which experience has shown to be necessary or advisable in certain types of tropical or temperate forests discussed. Natural regeneration, the conditions under which natural or artificial regeneration should be employed (Is it possible to lay down any hard-and-fast rule in this matter, apart from what the individual locality prescribes ?), and the value of mixtures were considered. In the case of afforestation in temperate climates, wide spacing was generally advocated in the case of fast-growing eucalypts and Douglas fir ; in South Africa, wide spacing (within limits) is said to reduce the costs of planting and weeding.

The total land area dealt with by the statements presented to the Conference is approximately 8,587,000 square miles, the total forest area, 1,910,000 square miles (in practically equal proportions of soft-woods and hard-woods), of which at present only 33 per cent is classed as merchantable. The area definitely dedicated to timber production is placed at about 214,250 square miles.

The progress made during the past five years is regarded as satisfactory and in some cases remarkable. It will be evident that in the parts of the Empire where forestry has been established on an organised basis for a considerable period, this progress will only be fully appreciable to the experienced professional forester ; whilst where the introduction of organised management is of more recent date, the advance made is far more striking from the public viewpoint. Thus, to quote the examples given, in Great Britain, South Africa, and New Zealand there has been a great increase in the rate of planting by government agency, the combined figures for the three countries being 89,000 acres in 1928 against 23,000 acres in 1923. New forest services have been constituted in British Guiana and Nova Scotia, and it is satisfactory to learn that others are contemplated. The statement is made, however, that "it is feared that some parts of the Empire are still oblivious to their obligations". It may be hoped that copies of this report will be submitted to the authorities concerned, for it should awaken them to a sense of their duty in forestry matters.

The discussions of the Conference embraced amongst other topics forest policy, Australian forestry, New Zealand forestry, education, Empire forestry bureaux and forest products research, labour in relation to forestry, climate and erosion, research in sylviculture, forest pests, fire protection, finance, utilisation, and experimental work with exotics. A few of these will be glanced at here, others being left for future consideration.

On forest policy the Conference was in some respects very sound. Emphasis was laid on the need for considering forestry in its national and imperial aspects, rather than as a simple matter of provincial or local concern. The view was advanced that central governments should take the lead in matters of policy, except where they are constitutionally precluded from so doing (it may be hoped that such instances will be very exceptional), laying down policy and taking control of legislation, general management, the alienation of reserved forest, the recruitment and training of superior staff, and research. Legislation might provide for the protection of water sources, prevention of erosion and shifting cultivation ; and in certain cases Government might assume, on conditions, the management of private forests in the public interest. The importance of making provision for local supplies of timber and fuel by the reservation or afforestation of areas near centres of consumption, including agricultural districts, was emphasised. In this connexion the importance of providing this type of forest produce might justify the utilisation of land fit for agriculture. It was correctly considered that local or communal forests should be under the management of trained officers working under a forest department, whatever might be the destination of the profits of working. The education of the public on the subject of the aims and utility of forest preservation was also discussed.

The lines upon which sylvicultural research work is now undertaken are fairly well known, and the Conference merely emphasised them ; the procedure evolved in India being the one adopted, so far as the Empire is concerned. The discussion on climate and erosion provided nothing fresh, but it paved the way for a consideration of the catchment area of the Murray River and its importance with reference to the Hume Weir.

Under finance, attention was directed to the fact that the indirect benefits from forests cannot be expressed in terms of money, though they are often greater and more vital than in other industries. "Forestry is such a long-tenure investment that, if compound interest is charged, there are no other comparable investments from which to determine the

[1] "Third British Empire Forestry Conference, Australia and New Zealand, 1928". (Government Printer, Canberra, Australia.)

rate." Many indirect benefits of the forest are well known, but even amongst the experts there was some difference of opinion as to what extent the indirect benefit argument should be used when such benefits cannot be assessed in definite terms. Compound interest should not be neglected altogether, but the rate should be below the current rate of money. It was argued in support of this contention that the national wealth does not in fact increase over long periods of time at a compound interest rate approaching 5 per cent, that forests increase automatically at compound interest, that they are a form of compulsory saving, and that the products of forests are independent of variations in the value of money—arguments which deserve to be more widely known and appreciated.

Finally, the Conference discussed the question of exotics. The need of careful experimental work before launching out on a large scale planting programme was emphasised. This warning is by no means a new one. In the past, however, a study of planting programmes furnishes evidence that each country has considered to a large degree that the warning does not apply to its own individual areas and work, the reiteration of the well-known dangers only applying to other parts of the Empire. The introduction of exotics usually (though by no means invariably) takes place when indigenous forests are lacking, when the indigenous species are of slow growth, or do not provide certain classes of timber essential to the country. "While suitable species should first be looked for in countries with similar climates, cases have occurred in which a species had been successfully introduced under climatic conditions quite different from those of its habitat." Therefore it was not possible to be dogmatic in this matter.

International Fisheries Investigations.

VOL. 49 of the *Rapports et Procès-Verbaux des Réunions*, Procès-Verbaux (Juin 1928), Conseil Permanent pour l'Exploration de la Mer (Copenhague: Andr. Fred. Høst et fils), shows abundant activity on the part of the various countries (now amounting to fifteen) involved in international fisheries work. The twenty-first re-union of the Council took place in Copenhagen in June 1928 under the presidency of Mr. H. G. Maurice. The reports and programmes of the area committees are mainly concerned with fishes, chiefly herring, plaice, cod, and haddock, expecially in the north-eastern and north-western areas, with sardine, hake, and tunny from the Atlantic Slope, salmon and sea-trout from the Baltic area, whilst special attention is given by the Hydrography Committee to salinities. An important memorandum is included with regard to plankton research. The old method of study by means of long tables with the comparative quantities of species present roughly noted is now almost universally abandoned, and exact quantitative methods substituted; the plankton is studied together with hydrographical data in connexion with the distribution of fish eggs and larvæ, and the results published in a special section of the *Bulletin Hydrographique*.

The report from the North-Eastern Area shows that more investigation has been done than ever before, Norway contributing oceanographical and plankton work, biological statistics of cod, sprat, and herring, and marking of cod, including a series of researches on the coast of More in close connexion with the whale fishery from the Whaling Station at Aukra, in which water and phytoplankton samples were taken besides zooplankton hauls, the laboratory at Aukra being busy the whole season in collecting observations on whales and the euphausiids which form their food. In the Lofoten and Finmark waters the plankton was in most places extremely meagre during the spring, the reason being (at any rate with regard to the phytoplankton) the scarcity of the nitrates and phosphates, which were almost totally absent from the upper water layers down to a depth of 50-100 metres, that is, throughout the whole thickness of the photozone, while very rich supplies were found in the deeper water. Stress is laid on the extreme importance to fishery research of the simplifications of method in investigating the fertilising substances, which were introduced by Atkins and Harvey of the Plymouth Marine Biological Laboratory.

The Consultative Committee welcomed the communications of the Danish Foreign Office on the intended agreement between Denmark and Germany relating to the regulating of fishing in the Western Baltic, and with regard to whaling an important point was the action of the Norwegian Government in communicating a draft bill for the extension of regulations now in force in the Falkland Islands and their dependencies to the pelagic whales which, up to this time, have been free from restrictions.

The arrangement of scientific meetings at these reunions is an innovation, the subjects of the first series being the estimation of nitrogen and phosphates in sea-water and racial investigations on food fishes (see NATURE, May 4, p. 697). It was recommended that the discussions for next year's general meeting should be on current measurements, direct and indirect, and fluctuations in the abundance in the stocks of food fishes.

University and Educational Intelligence.

THE American National Research Council's Information Service has recently issued two pamphlets —one on doctorates conferred in the sciences by American universities, and the other on funds available for the support and encouragement of research in science and technology. The former, an annual publication, gives the titles of all the 833 science doctorates conferred in 1927–28 classified under nineteen subject headings: chemistry, 269; zoology, 89; physics, 78; psychology, 66; botany, 61; mathematics, 44; geology, 35; agriculture, 31; pathology, 31; bacteriology, 29; engineering, 28; physiology, 28; seven other subjects, 44. The funds for research enumerated in the other pamphlet do not include those available for graduate scholarships and fellowships, particulars of which have been given in another publication (*Bulletin*, No. 38, 1923), but only those available for the encouragement and support of research in the form of medals, prizes, grants, or institutional funds. Of the 200 medals and prizes, 34 are for engineering subjects. Geography comes next with 8, and then astronomy and medicine, each with 7. Among organisations contributing to the advancement of science, Science Service (B and 21st Streets, Washington, D.C.) is noteworthy for its success in combining research and news activity, especially in its earthquake reporting service. In the fields of anthropology and archæology competent investigators are sent to alleged archæological finds, and reports made to Science Service for news purposes.

EDUCATIONAL broadcasting has been steadily developed by the British Broadcasting Corporation and now constitutes a very important part of its

service. Recent developments in this field were the theme of a paper read by Mr. H. Lynton Fletcher, of the B.B.C., at a meeting of the Royal Society of Arts on April 24 (*Jour. Roy. Soc. Arts*, July 19). In October 1926 a joint committee of the British Institute of Adult Education and the B.B.C. was set up under the chairmanship of Sir Henry Hadow. The report of this committee, signed on Mar. 15, 1928, and published under the title of "New Ventures in Broadcasting", suggested the establishment not only of a national central council for broadcast adult education, but also one to take charge of broadcasting to schools. The two councils thus suggested have been established with wide powers of direction and control. Meanwhile, for the purpose of dealing with technical problems, the B.B.C. has maintained since 1926 a staff of 'education engineers', now numbering fourteen, who advise on the improvement or construction of receiving sets, answer teachers' inquiries about the claims of educational broadcasting, and collect and pass on to the sections of the B.B.C.'s education department concerned information regarding school conditions and teachers' suggestions, criticisms, and difficulties. The number of schools visited by request in 1928 was 2276. Specifications for one, two, three, and four-valve sets suitable for use in schools and by adult education organisations have been drawn up and are available free of charge to all who are concerned with the work. Mr. Fletcher's survey includes a lucid exposition of principles, and constitutes, with the record of the discussion which followed the reading of his paper, a valuable contribution to the literature of educational broadcasting.

IN "Major Trends of Education in other Countries" (Washington, D.C.: Government Printing Office, pp. 48, price 10 cents), the specialist in foreign education of the United States Bureau of Education presents a digest of recent educational statistics and reviews the activities of educational institutions in all other parts of the world. For higher education there were established between 1920 and 1926 more than 150 new bodies: of the usual university type, 15; distinctly scientific in purpose, 55; concerned with sociology 26, pedagogy 24, health 20, agriculture 9, commerce 7. Summaries are given of some recent developments in university education in France, Germany, Greece, Italy, Palestine, Russia, China, and India. Secondary education has, says the review, exhibited five general tendencies since the War: to become more easily accessible to capable children of poor parents, to postpone determination of later careers, to facilitate transition between parallel courses, to incorporate the technical and vocational schools more closely into the general school system, and to prolong compulsory school attendance: recent developments in Austria, Prussia, France, and England are summarised. In the section relating to elementary education, attention is directed to the very general prevalence in Europe of a sentiment in favour of the practical and concrete as opposed to mere verbal knowledge, and a belief in the theory that the school should provide scope for the spontaneous activity of the child, the teacher being an adviser rather than a disciplinarian. The application of these ideas is carried to extreme lengths in the work schools now common in Russia, where most of the activities are controlled by the pupil, no scale of grading is used, and the school certificate states that the pupil has "studied and learnt to apply" the subjects mentioned in it: their influence is traced in recent changes in Austria, France, Italy, Poland, England, and New Zealand.

Calendar of Patent Records.

August 25, 1810.—The modern food-preserving industry is based on the process of sterilisation by means of heat in hermetically sealed containers invented by Nicholas Appert, for which an English patent was granted in the name of Peter Durand on Aug. 25, 1810. No French patent was issued for the invention, but as in the case of Daguerre, the value of Appert's process was recognised by the French government, and he received a grant of 12,000 francs in lieu of a patent. Appert published a description of the process in his book "Le livre de tous les ménages" in 1810, which ran into several editions and was translated into English in 1811.

August 26, 1825.—On Aug. 26, 1825, was enrolled the specification of the patent granted to Cornelius Whitehouse for the manufacture of iron tubes for gas and other purposes, which laid the foundation of the welded iron-tube industry. The process revolutionised the trade, the tubing being much stronger and more uniform, and the cost of production being reduced to about one-half. The patent, which was assigned to James Russell, Whitehouse's employer, was assailed in the courts, but on every occasion was upheld, and was finally extended for six years, one of the conditions of the extension being that Whitehouse was to receive an annuity of £500.

August 26, 1856.—Mauve, the first of the aniline dyes to be discovered, was patented by Sir William Henry Perkin on Aug. 26, 1856, and the commercial production of the new dyestuff was started the following year in a factory at Greenford Green, near Sudbury. The discovery gave a great stimulus to the study of organic chemistry, and the factory at Greenford and other establishments started in England continued to flourish with the ever-increasing production of new colours. When Perkin retired in 1874 to devote himself to research, the industry was well able to hold its own, but the position was not maintained for long in the face of foreign competition.

August 27, 1841.—The patent granted to H. W. Jenkins, manufacturer of Worcestershire, on Aug. 27, 1841, describes a machine for inserting pins into the crinkled paper holders in which they are sold. The pins drop from a hopper on to a grooved plate, so that a pin is deposited in each groove. The paper is hung over a ribbed bar in front of the plate and grooved transversely to correspond, and is crinkled by means of a second bar pressed down on to it. Whilst the paper is so held, the pins in the grooves are pushed through the folds of the paper, and the operation is repeated in another part of the sheet.

August 29, 1799.—The D-shaped slide-valve which is the most common form of valve employed for steam-engine cylinders, was patented by William Murdoch on Aug. 29, 1799.

Aug. 30, 1881.—A forerunner of the wireless broadcasting of to-day was the electrophone, in which music and dramatic performances were regularly transmitted over the ordinary telephone wires from selected theatres and concert-halls to special subscribers. The most generally used transmitter for this service was that invented by Clement Ader of Paris and patented by him in Germany on Aug. 30, 1881. French and English patents were issued the same year.

August 31, 1830.—One of the earliest successful patents for a railway-carriage wheel was that granted to William Losh on Aug. 31, 1830. Wrought-iron spokes, which were cast into the cast-iron nave, had elbow bends and curved prolongations which were joined one to another to form the circular rim of the wheel, on to which the wrought-iron tire was directly shrunk.

Societies and Academies.

PARIS.

Academy of Sciences, July 17.—**S. Drzewiecki**: The determination of the velocity of sound, based on the kinetic theory of gases.—**Marcel Picard**: A method for the determination of the ohm in absolute units.—**Jean Becquerel**: Introduction to a theory of the magnetic phenomena in crystals.—**Edgar Auber de la Rue**: The geological constitution of Heard Island.—**B. N. Zolotarevski**: The behaviour of *Locusta migratoria*, subsp. *migratorioides*.—**L. Lutz**: The soluble ferments secreted by the Hymenomycetes. Comparison of the anti-oxygen power of tannin and the phenolic constituents of the essential oils.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 8).—**V. Mitkevic**: Anomalous magnetic flux of a toroidal coil. (1) The case of a closed iron screen. Continuation of the investigations reported upon in previous papers by the author. The phenomena observed are easily explained on the basis of Faraday's views concerning the magnetic field.—**G. V. Pfeiffer**: Theorems elucidating a series of questions in the problem of the permutation of solutions of a linear equation with partial derivatives of the first order.—**A. Tolmačev**: The expedition of the Academy of Sciences to the Taymyr peninsula. The expedition lasted about a year and resulted in the discovery of several previously unknown mountain ridges, numerous other corrections in the map of the peninsula and in collections of its flora and fauna.—**A. N. Ivanov** and **A. Tsvetkov**: Spontaneous movements of daphnias. Spontaneous movements of daphnias were studied by the authors in comparison with the Brownian movements of particles and a very close correlation has been found.—**P. Schmidt**: The occurrence of the eel, *Uroconger lepturus* Richardson, in Japan. The species is widely spread in the Indian Ocean, being recorded from India, Sumatra, Java, Celebes, and the China Sea. Bleeker recorded it from Nagasaki, and the author found it in Kagoshima. Southern Japan is probably the northernmost limit of its distribution. A redescription of the species, with illustrations, is given.—**P. Schmidt**: *Hoplosebastes armatus*, a new genus and new species of the family Scorpænidæ from Japan. The genus is related to *Neosebastes* Guich., but differs in the absence of teeth on the palatines and in the strongly armed head; it is described from a single specimen taken at Nagasaki.—**A. Mordvilko**: Anolocyclic elm aphids *Eriosomea* and the distribution of elms during the tertiary and glacial periods. Species of the four genera belonging to the group *Eriosomea* live on *Ulmus spp.* and migrate to other plants. The migrants of some species are found in the areas where there are no elms at present, for example, in Africa, suggesting that these trees existed there at some former geological period.

SYDNEY.

Linnean Society of New South Wales, April 24.—**G. H. Hardy**: On the type locality of certain flies described by Macquart in "Diptères Exotiques, Supplement 4". About 140 species of flies are described by Macquart as from Tasmania in this work. It has long been known that the locality is erroneous in several cases; close study has indicated that many other species may also be wrongly localised, and it is a question whether all or practically all may not have come from Sydney and not from Tasmania. By making this change in location, the identity of many outstanding species may be ascertained.—**G. H. Hardy**: Notes on the identity of described Australian flies of the genus *Cerdistus* (Asilidæ). The descriptions of some of these flies, described by Macquart as from Tasmania, agree with species from the mainland, and not with those that occur in that island. This amendment in location has enabled the adjustment of synonymy hitherto unsuspected.—**J. R. Malloch**: Notes on Australian Diptera (19). Presents notes on some of the Tachinidæ describing as new four species of *Hyalomyia* and one species of *Actia*.—**H. J. Carter**: Australian Coleoptera. Notes and new species (6). Describes as new one species of Lucanidæ, four of Buprestidæ, one of Dascillidæ, six of Tenebrionidæ, two of Cistelidæ, and two of Cerambycidæ. Notes are given on synonymy of a number of species of *Stigmodera* and a revised key is presented for the species of *Hybrenia*.—**G. P. Whitley**: Fishes from Ongtong Java, Melanesia. A list is given of species of fish recently collected at Ongtong Java. Macleay's species, *Pseudupeneus filamentus*, is redescribed and referred to a new subgenus.—**W. L. Waterhouse**: A preliminary account of the origin of two new Australian physiologic forms of *Puccinia graminis tritici*. Several definite physiological forms of wheat stem rust have been determined from Australian uredospore material during the past eight years. In the spring of 1928, inoculation of barberries with teleutospores of (1) *Puccinia graminis tritici* 34 and (2) a mixture of *P. graminis tritici* 34 and 43 gave rise to the spermagonial and æcidial stages in (1), and to the spermagonial stage in (2). Following upon spermatial intermixing of (1) and (2), from (1) were derived cultures of Forms 11 and 34, and from (2) a new form otherwise unrecorded. Form 11 and this new form have not been found on any other occasion during the investigation.

Official Publications Received.

BRITISH.

Indian Central Cotton Committee: Technological Laboratory. Bulletin No. 18, Technological Series No. 13: Ginning Percentage and Lint Index of Cotton in relation to the Number of Cotton Fibres per Seed; the Effect of Environment on Ginning Percentage and the Determination of Unit Fibre-Weight. By A. James Turner. Pp. ii+41. (Bombay.) 1 rupee.

Journal of the Royal Statistical Society. New Series, Vol. 92, Part 3. Pp. viii+321-485. (London.) 7*s.* 6*d.*

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 40, Part 2, 19th July. Pp. 105-196+plates 5-14. (London: Edward Stanford, Ltd.) 5*s.*

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 59, January to June 1929. Pp. 272+23 plates. (London.) 15*s.* net.

The Chadwick Trust: a Short Account of its Founder, its Objects and its Work. Second revision. Pp. 28. (London.)

FOREIGN.

Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt. Band 4, No. 8: De svenska vattendragens arealförhållenden. 7: Lijungan och Lijusman M.FL. (Flodområdena n:ris 42-48.) Av Gustaf Wersén. Pp. 16. 1.50 kr. Band 4, No. 5: Kartor över vattenmängden och sjoprocenten i sverige. Av Gustaf Slettenmark. Pp. 7+4 kartor. 1.50 kr. (Stockholm.)

Abisko Naturvetenskapliga Station. Observations météorologiques à Abisko en 1928. Redigées par Bruno Wolf. Pp. iv+66. (Stockholm.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 8, 1926. iv: Meteorologiska iakttagelser i sverige, Band 68. Pp. x+177. (Stockholm.) 7.00 kr.

Diary of Societies.

CONGRESS.

AUGUST 31 TO SEPTEMBER 6.

NATIONAL VETERINARY MEDICAL ASSOCIATION (at Ayr).—The papers to be read include the following:—Foot-and-mouth Disease, J. O. Powley; Lameness, Prof. J. J. O'Connor; The Mineral Requirements of Farm Animals, Dr. J. B. Orr; Johne's Disease, Major G. W. Dunkin; The Clinical and Epidemiological Aspect of the so-called Hysteria of the Dog, Prof. F. T. G. Hobday.

On Sept. 3 at 1.45 a Popular Public Lecture on Tuberculin Testing, by Prof. J. B. Buxton.