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Organic Chemical Research in relation to Industry.

AT the Bristol meeting of the British Association a discussion took place in Section B (Chemistry) on the position of the dyestuffs industry in Great Britain and the effect which the passing of the Dyestuffs Act, ten years ago, has had on the development of the industry and on activities connected therewith. The matter is of importance, because, unless some step is taken to renew the Act, either in its present or in a modified form, it will automatically lapse in December of this year.

Three questions arise in connexion with the working of the Act, and it is upon the answers to these questions that the issue depends. They are :

(1) What was the purpose of the Act ?

(2) Has it achieved that purpose ?

(3) If the answer to (2) is in the affirmative or qualified affirmative, will the lapse of the Act tend to re-establish the conditions which it was enacted to alter ?

In connexion with the first question, it is perhaps well to remember that the Act is an unusual measure, since it prohibits the import of all dyestuffs and intermediate products related thereto unless under licence. Licences are granted by a committee composed of dye-makers and dye-users, with a certain number of neutral members, and are issued in cases where the substances required are not manufactured in Great Britain.

The object of the Act is stated in an announcement made by the Government in 1920, which read as follows : " It is the settled opinion of the Government that for national security it is essential that synthetic colour-making factories should be in existence and be maintained in operation with their staffs of chemists and other experts in this country, and that the equipment should be equal in extent to that of any other possibly hostile nation."

This statement dealt with the subject from the point of view of national security in time of war—a matter of the highest importance, but one that has been stressed so often that no further comment is necessary here. The existence in Great Britain of highly trained chemists in control of plant and equipment of a type readily adaptable to the purpose of the manufacture of munitions of war is, unfortunately, essential until conditions are reached which will render the most elementary precautions unnecessary. Nevertheless, it is clear that the object of the Act was the establishment of a strong industry in connexion with the manufacture of dyestuffs and the intermediate products from which

they are derived, which would serve as a means for development and progress in times of peace but which would also be available in time of war; for it must be remembered, in the latter connexion, that it is the simplest of operations to utilise, at a moment's notice, the plant and personnel employed in dye and intermediate manufacture for the purpose of producing munitions of war. Moreover, it should be realised that, although not expressly stated, the Act covered and has influenced a far wider field than that it was designed to foster, because many substances dealt with in the fine chemical industry, and in industries dealing with medicinal substances and organic compounds of chemo-therapeutic interest, are either directly or indirectly related to the dyestuffs intermediates and are, therefore, covered by the Act.

The answer to the second question—Has the Act achieved its purpose?—will be found by reference to the record of the meeting of Section B and to an excellent pamphlet just issued by the Association of British Chemical Manufacturers. The latter document deals with the views of the dyestuffs manufacturers on the progress which has been made under the Act of 1920, and although essentially an 'ex parte' statement, is nevertheless so concisely and clearly expressed that opponents to the extension of the Act, if such there be, will have some difficulty in combating the very cogent facts contained therein. The industrial and other difficulties which have militated against the development of the industry are enumerated and the conclusion is reached that, in spite of these, the Act has largely succeeded in achieving its main object, and that, as a consequence, we now have a well-organised, technically efficient, and virile industry. The 1929 production was more than six times that of 1913 by weight, and the home production now provides ninety per cent of the home consumption by weight and seventy-four per cent by value. The conclusion reached is that "while a sound foundation has been laid, and a strong structure is steadily being erected on efficient lines, there is still considerable headway to make before the industry can meet the full requirements of the colour-users, secure its proper share of the export trade, and withstand unaided the intensive foreign competition and price cutting which would result if this Act were allowed to lapse. The removal of the present protection would jeopardise the consummation of the work which it was the object of the Act to achieve." The dye-makers put forward the suggestion that, in order to ensure that no hardship should be placed on the colour-users, the Act should be extended in a form which will provide that prohibition of imports will only apply where a British maker is prepared to supply an equivalent product at an equal price.

In the summary of conclusion reached by the dye-makers it is stated that "the industry employs a larger proportion of technically-trained men than probably any other manufacturing industry in this country, and its existence is essential for the adequate maintenance of instruction and research in organic chemistry which are vital to our national prosperity and security". In other words, our research schools in organic chemistry are dependent on the industry for the employment of the trained men they produce, and, on the other hand, the industry is dependent on the schools of research for providing the skilled chemists without whom its work would be impossible. Prior to the War, manufacturers in Great Britain did not realise the need for highly trained men for service in the industry. Usually, all that was considered necessary was that a man should have obtained a sound general training in chemistry and allied subjects. It is certain that the pre-War predominance of Germany in scientific manufactures, and the fact that, in this connexion, we were rapidly becoming a nation of merchants, was due to the difference between the methods of training in the two countries. In Germany every chemist received a training in the methods of research, whereas in Great Britain probably ninety per cent of those seeking employment after graduation obtained no such training but entered the industry directly they had finished their course. Of the ten per cent remaining, the greater proportion went abroad to receive further instruction. Nowadays all that is altered.

Manufacturers have come to realise that, whether it is intended to place a man in the works as a process chemist, or whether it is intended that he should, in the first instance, enter the works' research laboratory, it is essential that he should have received at least one if not two years' training in research methods after graduation. It is fashionable in some quarters to disparage the Ph.D. degree, and to doubt the wisdom of the universities which have introduced it. No one who has any knowledge of the working of a large organic research school would do this. The degree is usually conferred after two years' training in research and indicates that the holder has undergone this training. It is a definite hall-mark which manufacturers are beginning to recognise, because they understand that the chemist possessing it has been trained to think. They know that no system of education can supply a student with the technical minutiæ of

their manufactures—these can only be provided by them on the spot; but they know full well that a man with a trained mind will pick up those details very much more rapidly and effectively than one without such an advantage.

When the whole field of organic chemical research is envisaged, one realises the vast importance of the subject and the need to prevent any occurrence which may in any way hamper or hinder its development. There are strong schools of research in most of our universities and university colleges, and from these emanates a steady stream of thoroughly trained men which is quickly absorbed into the industry. There is no lack of employment. Indeed, during the past few years the demand has been in excess of the supply and heads of organic research laboratories have often been unable to provide the men asked for. Moreover, the demand is increasing, and this must inevitably be so, because the number of industries based on organic chemistry is increasing and is bound to increase. Closer touch will also be effected between chemical industry and the research laboratories and further schemes will be devised for linking up the two, whereby the great potentiality for investigation and discovery resident in the universities will become available industrially.

It has been suggested that a certain measure of danger underlies the possession by a nation of strong and wealthy industries based on science, in that the best men turned out by the research schools may be attracted, by the offer of larger salaries, to abandon an academic career. If this were so, it would be fatal to the future development of both industry and academic science. If all the best men were attracted to industry, the second-rate men who remained would be unable effectively to control the research schools, which would then no longer be able to turn out first-class men. It is, of course, hopeless to suggest that matters could be adjusted by the universities paying salaries in any way commensurate with those obtainable in industry, but adjustment is certain to be reached by temperament: for in the future, as in the past, there will always be a number of first-class men to whom the 'loaves and fishes' of industry will offer no attraction, and who will be content to carry on research and investigation without any ulterior object. Moreover, there are many men to whom the love of teaching is a thing apart, and it is to these one must look for the adjustment of conditions which, at the present time, do undoubtedly present certain alarming features.

JOCELYN THORPE.

Taking Stock of Rubber.

(1) *Latex: its Occurrence, Collection, Properties and Technical Applications.* By Dr. Ernst A. Hauser. With Patent Review compiled by Dr. Carl Boehm von Boernegg. Translated by Dr. W. J. Kelly. Pp. 201. (New York: The Chemical Catalog Co., Inc., 1930.) 4 dollars.

(2) *Handbuch der Kautschukwissenschaft.* Herausgegeben von Prof. K. Memmler. Pp. xxiv + 766 + 10 Tafeln. (Leipzig: S. Hirzel, 1930.) 57·50 gold marks.

SCIENTIFIC investigation of rubber and rubber technology, apart from scattered researches, is a work of the present century. Growth of knowledge has been very rapid in the last decade, parallel with the enormous growth of the rubber planting industry in the East and of the tire industry in America and Europe. The two books under review give a timely and encyclopædic summary of current ideas in the field.

(1) Until a few years ago, latex, outside the producing countries, was only a colloid curiosity, but recent developments in its direct application, for example in the impregnation of textiles and in electro-deposition and dipping processes, have made it one of the most interesting materials in the rubber industry. Dr. Hauser was well fitted to write a monograph on the subject. He has made important contributions to our knowledge of latex, has investigated latex fresh from the tree in the East, and has studied one of the most urgent technical problems (that of latex concentration) intensively and on the works scale. In the result his book is admirably balanced and full of implications for further work. It may be said here, also, that the translation is done in lucid, enjoyable prose.

A historical introduction recalls the earliest patents for the use of latex, taken out in Great Britain by Samuel Peal and Thomas Hancock many years before the time was ripe for their inventions. The story is brought up to the foundation of the plantations from which the modern rubber industry dates. There follow chapters on the most important latex-bearing trees, on the collection of latex, the physical and chemical properties, non-rubber constituents of latex, less important latices, coagulation, evaporation, preservation and shipping, concentration, vulcanisation, and industrial applications. Chapter headings scarcely reveal the wealth of material dealt with in the book. Many difficult problems are critically examined and the text is frequently amplified by exhaustive bibliographies.

(2) Too many books devoted to general survey offer nothing but a superficial patchwork. Memmler's "Handbook" is very different from that; it is a comprehensive digest packed with detail, and offers an invaluable work of reference to the state of knowledge of rubber science at the present day.

There are seven main sections. The first, by Zimmermann, is devoted to the botany, cultivation, and preparation of rubber. There are chapters on every aspect of this field work, and such recent developments as electrophoretic and Emka rubber are discussed alongside *Hevea*, Manihot, and Jelutong. The chemistry of rubber is treated in the second section by Pummerer and Koch, and in this field we find the most important advances over the older text-books. Some chapters, such as those on halogen and oxygen derivatives of caoutchouc, contain little more than previous writers could say, but the chapters on the purification, crystallisation, and fractionation of rubber, on internal molecular rearrangement (cyclisation), on hydrogenation, and on the molecular weight and chemical constitution, show the remarkable progress recently made. A long chapter on synthetic rubber will be read with special interest on account of its author's association with the I. G. Farbenindustrie A.-G. The special question of vulcanisation is given a separate section by Kindscher and contains a good account of the part played by accelerators, while some less practical but theoretically interesting work on various types of vulcanisation, such as the Peachey process and the use of selenium and nitro-bodies, is adequately treated.

The fourth section, also by Kindscher, is on the chemical analysis of rubber. This is the one department of rubber science which has made little progress in recent years. The great interest taken in the mechanical testing of rubber, which began a couple of decades ago, has caused a definite neglect of chemical analysis. Such problems, for example, as the detection and determination of organic accelerators and preservative agents in rubber are barely touched upon; what little is said about them only emphasises the difficulties without throwing any helpful light.

The fifth section, by Hock, covers the fascinating subject of rubber physics. The mechanical structure of rubber stands out as the fundamental problem of rubber science in view of the unique mechanical behaviour of the material. In this book the structural conceptions are based on the thermo-elastic properties, and the important contributions of X-ray analysis to the subject are fully treated. Other chapters are devoted to the thermal, optical, and electrical properties of rubber, to its swelling and solution in fluids, and to rubber as a dispersing medium for filler particles. The sixth section, by Memmler and Schob, on mechanical testing, substantially follows the earlier work of Hinrichsen and Memmler, but contains valuable new sections on the plasticity of crude rubber and on ageing tests. The final section, by Pohle, constitutes the first general discussion of rubber microscopy yet written. It is illustrated with numerous beautiful reproductions in black and white and in colour of photomicrographs. The use and effect of stains in connexion with the dispersion of fillers is a revelation of delicate work.

Both these books conclude with full indexes of names and subjects, and are well printed.

T. R. D.

The Mosquitoes of North America.

A Handbook of the Mosquitoes of North America: their Structure, how they Live, how they carry Disease, how they may be Studied, how they may be Controlled, how they may be Identified. By Prof. Robert Matheson. Pp. xvii + 268 + 25 plates. (London: Baillière, Tindall and Cox, 1929.) 25*s*. net.

MALARIA, once very prevalent in the northern United States, has almost disappeared there, and is also less prevalent in the southern States, although here its diminution has been less marked and has proceeded at a slower rate. It has been suggested that the possible factors contributing to the decline of the disease have all been closely related to the agricultural development of the country, and, therewith, the reduction of habitats favourable to the breeding of the anopheline vectors. The danger of a serious increase of malaria in the northern States is not considered great, but under the less better developed conditions in the south, the likelihood of a recrudescence of the disease is much greater. In America, as elsewhere, mosquito campaigns in the past have been organised only when outbreaks of mosquito-borne diseases occurred. After the outbreak had diminished or disappeared, the passivity of responsible authorities frequently nullified the results of previous good work, and control operations had to be renewed with the recurrence of fresh outbreaks.

The successful control of mosquitoes depends on a thorough knowledge of their habits, which vary with the species. It is, therefore, essential that an exhaustive survey of the mosquitoes of the par-

ticular area to be controlled should first be made, including those that are migrants from adjoining districts, and finally, a topographical map of the area should be prepared showing the breeding grounds of the different species. With this information available, a definite plan for the ultimate reduction and elimination of breeding may be undertaken. Any plan will depend largely on local conditions, the extent and character of the breeding grounds, and the species of mosquitoes concerned. Whilst, then, malaria and yellow fever have been the greatest single factors conducive to the undertaking of active measures of mosquito control, it must not be forgotten that the anopheline carriers of malaria are but a mere fraction of the world's mosquito fauna, the majority of species of which are not concerned in the transmission of any disease, but thrust themselves unduly on the attention of man by their excessive abundance in certain regions and their irritating bites. Under such conditions, man's capacity for work and enjoyment in the open air is seriously interfered with, and valuable lands are rendered almost uninhabitable and remain undeveloped. This is particularly true of summer seaside and lake resorts, or urban areas subject to mosquito invasion, and of manufacturing and industrial districts.

In the United States the mosquitoes of New Jersey enjoy a reputation for bloodthirstiness that is second to none. Their abundance is traceable to the ideal breeding grounds, which occupy thousands of square miles of tidal salt-marshes adjoining the Atlantic seaboard. Here there flourish such migratory species as *Tæniorhynchus perturbans*, *Aedes vexans*, *A. sollicitans*, *A. cantator*, and *A. tæniorhynchus*. The abatement of the nuisance depends for its success on the ditching and drainage of the marshes. A true index of the success of the New Jersey anti-mosquito campaign is the steady appreciation in the land-values of adjacent residential areas during the past decade. Dr. T. J. Headlee, State Entomologist, New Jersey, is the authority for the statement "that where salt-marsh mosquitoes have been largely eliminated during the last ten years, there has occurred an average annual increase in taxable land-values of seventy-five per cent more than where they are still present or very recently reduced".

Problems of mosquito eradication similar to those of New Jersey also exist in California. In the valleys of most of the larger rivers of North America there occur special problems of mosquito control due to the annually recurrent conditions of flooding produced either by the melting snows of spring or the early summer rains. The mosquito pestilence of the lower Fraser River valley is entirely due to such conditions, and in some years assumes such proportions as to interfere seriously with the outdoor activities of the agricultural communities scattered along the valley. Likewise dependent for their development on the pools formed as a result of the melting snows are the majority of the species of *Aedes* of the northern Canadian prairie and tundra lands of the North-West Territories. No summer traveller to the Arctic but has experienced the annoying persistence of the countless myriads of *Aedes*, which in point of actual numbers far transcend any mosquito plague of the tropics. These northern species are but single-brooded, hatching from eggs deposited at random in the vegetation the previous summer. Whilst the period of overwintering diapause or latency only terminates with the recurrence of the requisite conditions of spring moisture, it is frequently prolonged so that many eggs only hatch after two or more periods of submersion separated by longer or shorter intervals. A comparable prolongation of the egg-stage of *Aedes argenteus* has recently been explained by Roubaud[1] (1929), not so much as an adaptation enabling the species to survive periods of dryness or unfavourable winter conditions, as a period of reactivation, during which the inhibitory effects of inherited toxins are overcome.

In connexion with mosquito breeding, one of the most urgent problems awaiting solution is the ascertaining of the physical, chemical, and biological factors, which determine the presence of certain species of mosquito larvæ in some pools and their absence in others. Variations of the *p*H values do not alone seem to offer a satisfactory explanation. Recent investigations would indicate that specific substances present in the water or produced by the decomposition of vegetable matter may be responsible for the growth of specific micro-organisms suitable or unsuitable as food for the larvæ.

The book before us discusses in a conventional manner the facts of mosquito morphology and biology, the relation of mosquitoes to disease, and the methods now commonly employed in combating mosquitoes. The final two chapters of the book are devoted respectively to a systematic account of the North American species of Anophelini and Culicini; of the former 8 species are described, of the latter 73 species belonging to 9 genera. It will serve as an admirable introduction to the more comprehensive work of Howard, Knab,

and Dyar, "The Mosquitoes of North and Central America and the West Indies", and of Dyar's "The Mosquitoes of the Americas". One of the great drawbacks to the advancement of culicidology has been the irksome synonymy, for which systematists and other students of the group have been largely responsible. It is, therefore, refreshing to those weary of tracking species invested with a protean nomenclature to find that at last systematists are beginning to agree upon the identity of many of our nearctic and palæarctic forms, with a consequent welcome reduction of spurious species. Further investigation will doubtless show that many others are merely varieties and not valid species.

The book is well illustrated by 23 text-figures and 25 plates, 7 of which are photographs of the breeding habitats of common species, whilst the remainder are composed of clear diagrammatic representations of larval and adult structures important in identification. There is a useful general index.

A. E. CAMERON.

[1] Roubaud, E. "Recherches biologiques sur le moustique de la fièvre jaune. *Aedes argenteus* Poiret. Facteurs d'inertie et influences réactivantes du développement. Les œufs durables et leur importance dans le rajeunissement du cycle évolutif." *Ann. Inst. Pasteur*, no. 9. Paris, 1929.

Prof. Whitehead's Philosophy.

Process and Reality: an Essay in Cosmology. (Gifford Lectures delivered in the University of Edinburgh during the Session 1927–28.) By Prof. Alfred North Whitehead. Pp. xxiii + 509. (Cambridge: At the University Press, 1929.) 18*s*. net.

IT does not fall within our scope to attempt a detailed or technical examination of the volume of Gifford Lectures in which Prof. A. N. Whitehead has expounded at greater length than elsewhere his system of metaphysics. This has been done in many other notices, and we would be understood here only to give a general impression from rather a lay point of view, comparing it with other newly published syntheses of similar scope—for example, that of Profs. Alexander and Haldane, Pringle Pattison and Hobson, and Sir Arthur Eddington.

Gifford lectures always open up a prospect of such fresh attempts to bring together the conclusions of science and put them into some sort of living relation with religion. It is an increasingly difficult task, and one should be grateful to the valiant men who essay it and the foundation which encourages them. It is doubtful, however, whether much has yet been achieved in the direction which most of the lecturers have had in view, mainly for two reasons: either they restate their old religious and metaphysical preconceptions side by side with a summary of certain aspects of recent science—this was the method, among others, of two eminent Gifford lecturers, Eddington and Haldane—or they undertake quite a new construction of their own, with a new phraseology and new ideas very difficult to accommodate to accustomed usage; Prof. Whitehead is the greatest example of this type, Prof. Alexander inclining towards him, but with much more tenderness to our traditional language and ways of thought, and also—the most important point—a much more thorough and accurate psychological analysis.

In Prof. Whitehead's work, whether in this volume or in the better-known "Science and the Modern World", we are constantly enlightened by some inspired phrase or conducted to a new vista of unity between the thinkers of the past and the opening realms of thought in the future. In this sense Prof. Whitehead is himself one of the builders of unity, a potent force in the new renascence of "the universe which is thus a creative advance into novelty". But when we turn to the system itself which he has elaborated with so much patience and ingenuity, we are overwhelmed by a cloud of perplexities and doubt.

The first and most obvious cause of this embarrassment is the extraordinary obscurity and redundance of the language. Here is a comparatively simple sentence, selected rather for that reason out of a multitude of others which on every page have confounded the wits of the most practised readers: "The depositions of Plato, Aristotle, Thomas Aquinas, Descartes, Spinoza, Leibniz, Locke, Berkeley, Hume, Kant, Hegel, merely mean that ideas which these men introduced into the philosophic tradition must be construed with limitations, adaptations, and inversions either unknown to them or even explicitly repudiated by them." What does this sentence tell us except that "No philosopher's words can be taken as final"? This, however, is a simple case. The greatest difficulty arises when the author adds to this redundancy of ordinary expressions the whole apparatus of a new terminology which he has himself invented and he himself remains the only writer to employ. No doubt an author is justified in introducing words carefully framed to express ideas which he cannot find adequately expressed in accepted phraseology. But clearly he must, if he wishes to be read and understood, do this with the utmost care and moderation.

Now, Prof. Whitehead, thinking that he has a great new idea to expound which dominates all his thought, has not only transformed one familiar word to express this new thought, but has added to it a whole string of others which constantly recur in the midst of long and complicated sentences. The leading word transformed is, of course, 'organism', and with this come entity, superject, prehension, concrescence, and many more. Some are new coinage, others are old words used in a novel and not always strictly consistent sense.

This coinage of new words goes further than merely verbal explicitness—which, in fact, it does not secure. The deeper difficulty is that having set up the one great idea with its new denomination of 'organism' and 'organic', the author is apt to proceed and to move in a completely new world of thought, more and more detached from the world of familiar fact from which he sets out.

This starting-point for the new philosophy is given in an early passage as follows: the "doctrine of the philosophy of organism is that, however far the sphere of efficient causation be pushed in determination of components of a concrescence—its data, its emotions, its appreciations, its purposes, its phases of subjective aim—beyond the determination of these components there always remains the final reaction of the self-creative unity of the universe. This final reaction completes the self-creative act by putting the decisive stamp of creative emphasis upon the determinations of efficient cause." This final 'self-creative unity' is what the author means by 'God', who is elsewhere defined, more briefly in the same direction, as "the principle of concretion".

One understands in a vague sense what this aims at. It has close affinities with other large general ideas current at the moment, especially Gen. Smuts's 'holism'. It has a value, no doubt, in raising the mind above the complexities of particular events: above all, in connecting the idea of creation with that of increasing order and unity in the world. But when applied *ab extra*, as it were, overriding the known distinctions, for example, of the living and not-living, the conscious and the unconscious, it confuses and does not enlighten us. For one reader at least, full of admiration for the author and sympathy with his general aim, more light comes from the less ambitious but more faithful psychological analysis of the school of Bradley and Alexander.

F. S. MARVIN.

Our Bookshelf.

Air Ministry: Meteorological Office. The Weather Map: an Introduction to Modern Meteorology. (M.O. 225i.) Second edition, entirely rewritten. Published by the authority of the Meteorological Committee. Pp. iv + 83 + 24 plates. (London: H.M. Stationery Office, 1930.) 3*s.* net.

THE first issue of "The Weather Map" was published in 1915, primarily in response to military requirements, and was in considerable demand for the succeeding ten years, as is shown by the fact that six reprints were made during that period. Mr. J. S. Dines, while superintendent of the forecast branch of the Meteorological Office, rewrote the work and brought it up-to-date.

There are numerous improvements in the new volume, the most obvious of which are visible at a glance in its better finish throughout, and especially in the cover and in the reproduction of the weather maps. It may be noted, however, that in order to exhibit the weather at individual stations clearly, the area covered by the maps is about the same as for those published in such morning newspapers as reproduce the map for 6 P.M. of the previous day. This area is very small compared with that of the 'working chart' of the official forecasters—a fact which should be borne in mind when considering the process of preparation of the forecasts. There must be a great many people who would follow with interest the changes depicted in these maps, could they master the meaning of all the symbols and figures that appear on them, and their requirements are well met in the full and clear exposition given of the make-up of a modern synoptic weather map.

To those whose interest carries them further, and who require some insight into the kind of reasoning followed by the official forecaster in making his diagnosis of a particular situation, the same attention has been paid, and there is little doubt that present-day technical methods of prediction have been made comprehensible to anyone with an elementary knowledge of physics, and not wholly unintelligible to those without such knowledge. It is good to see also that the history of the subject has not been neglected, and that a careful account has been given of the new ideas that have come to us in recent years from Norway owing to the analytical methods worked out by J. Bjerknes with the aid of a closer network of stations than is normally employed in synoptic meteorology. The amount of information and the clearness of its exposition are remarkable for the size of the volume. The teaching profession should derive especial benefit from its appearance.

In a Persian Oil Field: a Study in Scientific and Industrial Development. By J. W. Williamson. Second edition, revised and enlarged. Pp. 192 + 25 plates. (London: Ernest Benn, Ltd., 1930.) 7*s.* 6*d.* net.

IT is quite evident from the call for a second edition of this book that public interest in the oil industry extends beyond markets. Written originally for the non-technical reader to convey "a judicious

appreciation" of the work of a British oil company, apparently sales and certainly reviews commended the volume to the technologist, a source of gratification to its author, who modestly reiterates in his second preface its real purpose: to serve the general reader.

Probably one of the chief reasons for the success of this essay is the fact that it is unique of its kind. At first glance one might wonder, and with every reason, what there was in the business of oilfield exploitation to appeal to anybody outside those directly concerned, outside the technical circle. But the story of a self-contained British community operating in alien country, contending not only with a difficult people, but also with Nature in her sternest mood, every individual and collective effort directed to one goal, the winning of petroleum and all that this to-day stands for, provides an author with a wealth of material, technical, human, psychological, social, out of which, if he be worthy of his pen, he cannot fail to make abundant literary capital.

The chief departure from the first edition is the inclusion of a chapter on "Oil and Ethics", which, designed to portray the achievement of the company concerned in correct perspective of international industry, throws into sharp relief the other part of the book. Otherwise the alterations are mainly those of righting mistakes, revising sections which clearly wanted attention in the original, and extending the information on those particular operations, for example, geophysical, which have been prominent in the interim. To criticisms made to the reviewer, that the title is an intended parody on a popular song, and that the book is an excellent form of publicity for a commercial undertaking, we reply that, even if either or both are justified, anything which brings home to the general reader what a wonderful substance is petroleum, what praiseworthy enterprise and high standard of human attainment are involved in its exploitation, deserves the fullest approval. H. B. M.

Rudi Schneider: a Scientific Examination of his Mediumship. By Harry Price. Pp. xv + 239 + 12 plates. (London: Methuen and Co., Ltd., 1930.) 10*s*. 6*d*. net.

THIS volume gives an account of two series of sittings held under the auspices of the National Laboratory of Psychical Research, of which the author is the honorary director. The medium in whose presence alleged psychic phenomena are said to have taken place was a young Austrian, by name Rudi Schneider, who with his brother Willi have for some years held the position of the principal European mediums for the so-called physical phenomena.

The present series of sittings is said to have been held primarily in order to interest as many scientific men as possible, although the list of sitters scarcely lends support to this statement.

The control of the medium and observers was mainly exercised by an electrical device whereby any movements which resulted in breaking the circle were registered by the extinction of certain lights, and thus both medium and sitters were immobilised and (it is claimed) prevented from indulging in any trickery. Under these conditions a number of manifestations are recorded, such as the movements of objects without contact and the appearance of hands seemingly endowed with life. Notes were taken by a lady secretary, who dictated them into a dictaphone as the events occurred, but the few independent accounts that Mr. Price prints show that these notes should be regarded with some caution.

Generally speaking, the book is an interesting addition to the studies of the Schneider phenomena, although the treatment of past history is scarcely ingenuous. From its perusal the uninformed reader would scarcely gather that a formidable mass of evidence exists to justify suspicion regarding phenomena identical, or nearly so, with those now said to occur with the electrical control.

A History of Medicine. By R. McNair Wilson. (Benn's Sixpenny Library, No. 148.) Pp. 80. (London: Ernest Benn, Ltd., 1930.) 6*d*.

IN a very small compass, the author gives an excellent survey of medical history. Beginning with the medicine of the Greeks, he emphasises the influence of Hippocratic humoral conceptions and the later Roman 'methodist' theory and the Galenic theory of the pneuma upon the development of medical science. An admirable plea for recognition of the value of earlier English medicine is made, with special reference to the works of Harvey and Sydenham. Jenner's discovery of the use of vaccines is also well described, and this is followed by a good analysis of the work of Pasteur. From 1880, great strides have been made in antiseptic surgery and the application of antitoxic sera, and the author gives his readers a glimpse into this revolutionary period in medical history.

The book terminates with a brief review of the development of preventive medicine which has resulted in the establishment of the Ministry of Health and the Medical Research Council, the study of mental sickness, and cancer research. The work is altogether a splendid effort, and may be read with interest, both by medicals and laymen.

Plant Biology: an Outline of the Principles underlying Plant Activity and Structure. By Dr. H. Godwin. Pp. x + 265. (Cambridge: At the University Press, 1930.) 8*s*. 6*d*. net.

ELEMENTARY text-books of botany usually bear a strong family resemblance, and it is therefore a pleasure to notice one bearing the hall-mark of individuality. This book treats the plant as an active unit, and at the same time emphasises the physico-chemical bases on which it works. Particularly useful are the schemes showing the types of metabolism and energy relations of the yeasts and bacteria. We may welcome also the illustration of the tissue elements as solid objects, and also the developmental treatment given to the morphology of flowering plants.

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.*]

Crystal Structure of Parahydrogen.

WE have made two Debye-Scherrer films of parahydrogen cooled by helium boiling under normal pressure, yielding rather faint and granular lines. A much better intensity was obtained when the solid was irradiated at a temperature less than 2° K. The spacings which were deduced from these films cannot be explained by a simple space lattice of cubic symmetry.

A hexagonal close-packing of molecules, with $a = 3{\cdot}75$ A. and $c/a = 1{\cdot}63$, gives a satisfactory agreement between observed and calculated spacings. For the density we compute then 0·088.

A more detailed account of these experiments is being published in the *Proceedings* of the Royal Academy of Amsterdam.

W. H. KEESOM.
J. DE SMEDT.
H. H. MOOY.

Leyden, Oct. 30.

A Sex-linked Character in Ducks.

ALTHOUGH sex-linked characters are known in fowls, pigeons, doves, and canaries, none has hitherto been recorded in ducks. From the industrial point of view, a sex-linked character affecting the down of the newly hatched duckling, enabling the sexes to be distinguished at this stage, would be of considerable importance; for the runner duck, though a magnificent layer, is comparatively valueless for table purposes. It is true that the sexes can be distinguished by a careful examination of the cloaca even at hatching, but this as a rule demands more skill on the part of the operator than the average duck farmer possesses.

Some experiments carried out this year have revealed the existence of a sex-linked character which will probably provide the industry with what it desires. Reciprocal crosses were made between the common mallard and the Indian runner, a race with rather blurred markings on a buffish ground. From the mating between runner duck and mallard drake, 19 birds were produced, all with a dark type of down resembling that found in the mallard. Of these, 10 were drakes and 9 were ducks. From the mating between mallard duck and runner drake, 47 young were produced, of which 27 were drakes and 20 were ducks. The down of the drakes was similar to the down of all the ducklings from the reciprocal cross, but the down of the ducks was much lighter, and nearer in ground colour to that of the runner. The colours of the two types of down cannot be matched exactly in Ridgway's "Colour Standards", but the lighter one is close to the "light brownish olive" on Plate XXX., while the darker is not far removed from the "dark olive" of Plate XL. All the downs, whether light or dark, were yellowish on the ventral surface, and showed yellow rump patches dorsally. Such pale markings are not characteristic of the runner, and are probably due to a dominant factor brought into the cross by the mallard.

On reaching maturity, the birds with the dark downs exhibited a type of plumage closely resembling that of the mallard, whether male or female; but the ducks from the mallard ♀ × runner ♂ developed a distinct and paler type of plumage, which was noticeable also for the marked reduction of the characteristic bright 'speculum' on the wing.

In its general features the case recalls that of the 'cinnamon' canary, and it is interesting that in this species also the inheritance is sex-linked. Finally, it may be added that Werner (*Anat. Rec.*, 1925) has shown that the female runner, like all other birds adequately investigated, possesses only one X-chromosome.

R. C. PUNNETT.

Science and Philosophy.

THE suggestion by Prof. F. G. Donnan (NATURE, June 7, 1930) that an international conference of scientists and philosophers, and perhaps others, might help toward clarifying the present confused state of men's thinking on most of the major problems of Nature and human life, has received considerable notice—in America, at least.

A later communication to NATURE (June 21) by Mr. Wilfred Trotter directs attention to the extent to which the biological sciences have "lost prestige in the intellectual world" in the last thirty years, and "ceased to influence philosophic thought". No one who to-day views the field of human interest broadly and thoughtfully can fail to recognise the general truth of the point made by Mr. Trotter. If one desires an illustration of this truth in relation to philosophy, let him compare such writings as Prof. John Dewey's "The Influence of Darwin on Philosophy" (1909) and his "The Quest for Certainty", published just twenty years later. Or if one wants an illustration of the present standing of biology in the realm of ethics, he may reflect on the insignificant and hopeless creature man is from the "particular point of view which the biologist adopts" (Walter Lippmann, "A Preface to Morals", p. 150).

I venture to direct attention to a matter which, though far less than the whole problem of the relation between science and philosophy, yet has long appeared to me to have an important bearing on that problem. The point concerns the now widely adopted classification of the sciences into 'exact science' and 'natural science'. A brief historic reference illustrates what is in mind.

In the "History of Scientific Ideas" (2nd ed.; London, 1847) William Whewell wrote, quoting from his previously published "Philosophy of the Inductive Sciences": ". . . the mathematical and mathematico-physical sciences have, in a great degree, determined men's views of the general nature and form of scientific truth; while natural history has not yet had time or opportunity to exert its due influence upon the current habits of philosophizing".

That Whewell was greatly impressed by this idea is clear from his recurring to it under various heads and in others of his writings. Thus in his "Novum Organum Renovatum" (London, 1858) we read: "Natural history ought to form a part of intellectual education, in order to correct certain prejudices which arise from cultivating the intellect by means of mathematics alone; and in order to lead the student to see that the division of things into kinds, and the attribution and use of names, are processes susceptible of great precision".

These views were expressed by Whewell, it will be noticed, before the publication of "The Origin of Species" and Darwin's other works, which laid a solid foundation for the theory that man himself with all his attributes is a natural product and so holds a definitely ascertainable place in the world of living organisms. But Whewell's appraisal of natural

history referred only to its general educational and logical bearings. Natural history as dealing with that domain of Nature to which man himself belongs had received no serious consideration by him. Only since his time, and to the extent that man has accepted the theory of 'descent with modification' as applying to his own origin and nature, has it been possible for anybody to see that if ever man is to attain that measure of self-knowledge after which the wisest ones of all races have longed and striven, that knowledge must partake much more of the character of 'natural science' than of 'exact science', using these terms as they are now largely understood.

The following then is suggested as one opportune subject for treatment at such a conference as that proposed by Prof. Donnan: The ancient injunction, Know Thyself, may be placed on a scientific-philosophic basis by developing to its fullness the partial insight gained by William Whewell of a natural history mode of philosophising.

W. E. RITTER.

University of California,
Berkeley, California,
Oct. 9.

Ancient Metallurgy in Rhodesia.

MY attention has been directed to an article on "Early Man in N. Rhodesia", by Prof. Raymond Dart, which appeared in the *Times* of Aug. 22 and was noticed in NATURE of Aug. 30. Echoes of the statements made in the article are finding their way into our local Press, and the unprotected public is being told that iron was being fabricated "3000 to 4000 years" ago by a people of Palæolithic culture dwelling in central Africa.

On the face of it, such an accomplishment is highly improbable, because the oldest man-made iron of known date is that of the discovery made by Sir Flinders Petrie at Gerar, in Palestine, in 1927. The date of this iron, as determined by associated scarabs and amulets, is 1350 B.C. It is probable that the smelting of iron was begun a little earlier, say, 1400 B.C., in the Hittite uplands, between the Taurus and the Caucasus, a region to which classical tradition points as the cradle of metallurgy. All iron earlier than 1400 B.C. is probably of meteoric origin; many older relics have been tested for their nickel content (which is the criterion) and have proved to be of celestial metal. It is unlikely that the smelting of iron was known long before 1350 B.C., because the knowledge of the art would have been of supreme importance, in trade and war, to any primitive people; it would have sufficed to give them instant dominance over their contemporaries.

We must meet Prof. Dart's conclusion, therefore, with justifiable scepticism. He says: "These facts reveal the extreme age (3000 to 4000 years) of the knowledge of smelting and the working of metals in Northern Rhodesia". This dictum is based upon the finding, by an Italian scientific expedition, of a foundry, slag, and ashes at a depth of six feet in a deposit containing implements characteristic of the Stone Age. The deposit lies within a limestone cave at Mumbwa, near the Kafue river, a tributary of the Zambezi. The find is said to prove that "the smelting is coeval with the later phases of the Palæolithic period in Northern Rhodesia", and shows that "the knowledge of metallurgy was introduced by a superior race into an Africa still in the throes of the Stone Age". This is true enough, but it does not prove an antiquity of 3000 or 4000 years, that is, so long ago as 2070 B.C. What it does prove, I submit, is that foreigners, versed in iron-making, established themselves for a time in the cave, possibly for self-defence, and during their sojourn they made iron weapons for use against the natives, who then were using the "quartz flakes and quartz implements of the Late Stone Age type"—in short, were the savages that Livingstone, Cameron, and Stanley found in that part of the world seventy years ago.

The invaders probably were slave-hunting Arabs, and the date of their incursion may be anything from A.D. 1200 to A.D. 1900, but no B.C. chronology is permissible. The Italian expedition has not finished its exploratory research; perhaps when all the information available is collected we shall be given a more convincing interpretation of the facts.

Apropos of early iron-making, I may mention that sundry writers have imputed the ancient Egyptians' knowledge of the art to a borrowing from their southern neighbours, the Ethiopians, this idea being lent some colour by the fact that the natives in central Africa, more particularly the Kenya and Congo regions, know how to make iron in a crude manner. Crudity of method, however, does not prove antiquity of origin. The denial to any such supposition is found in the description by Herodotus of the weapons used by the Ethiopian contingent in the army of Xerxes. Their armament consisted of "long bows, on which they placed short arrows made of cane, not tipped with iron, but with stone that was made sharp, and of the kind of which we engrave seals. Besides these they had javelins, tipped with antelope's horn that had been made sharp, like a lance. They had also knotted clubs." All of which indicates a complete ignorance of metallurgy.

T. A. RICKARD.

Berkeley, California,
Oct. 6.

The Nature of the Vacuome and the Golgi Apparatus in Oogenesis.

I HAVE read with great interest the recent communications of Miss M. O'Brien and Prof. Gatenby (NATURE, June 14, 1930) and of Prof. Bhattacharya and Dr. Das (NATURE, Nov. 2, 1929) on the *Lumbricus* and the pigeon ovary respectively. For the first time these authors have demonstrated that in the egg cells also the vacuolar system (vacuome) and the classical Golgi apparatus are independent cell-components. A similar conclusion has already been arrived at in plant cells by Bowen (*Z. Zellf.*, 1928) and by Patten, Scott, and Gatenby (*Quar. Jour. Roy. Mic. Soc.*, 1928), in animal male germ cells, by Hirschler, Monné, Voinov, and Gatenby (for references see Gatenby, *Proc. Roy. Soc.*, 1929), and most recently in animal somatic cells also by Beams (*Anat. Rec.*, 1930), and by Gatenby and O'Brien.

Now both in the case of the earthworm and the pigeon ovary the use of neutral red has been found necessary to demonstrate the vacuolar system. Prof. Gatenby and his collaborator, therefore, have been naturally careful in stating that "it does not seem possible entirely to dismiss the idea that these globules might be segregation vacuoles and not pre-existing structures".

On the other hand, in the eggs of *Rana tigrina* (Nath, in press) and the teleostean fishes *Ophiocephalus punctatus* and *Rita rita* (Nath and M. D. Nangia, in press), not only the mitochondria and the Golgi elements but also the vacuoles can be seen *intra vitam* side by side separately *without the aid of neutral red or osmic acid.* This is due to the greater density and the larger size of the vacuoles of these three species. In *Ophiocephalus punctatus* the vacuoles begin condensing inside them protein material from a very early stage in oogenesis and actually form the albuminous yolk of the egg, as has been very rightly claimed for *Perca* and *Pygosteus* by Hibbard and Parat

(*Bull. d'Hist.*, 1928) and by Hibbard for *Discoglossus* (*Jour. Morph. Physiol.*, 1928).

In their chemistry the vacuoles of the eggs of *Rana*, *Ophiocephalus*, and *Rita* are diametrically different from the Golgi elements. Whereas the latter consistently go jet-black in either Da Fano or Mann-Kopsch or Kolatschev, and cannot be stained with neutral red, the former do not show the slightest amount of blackening however heavy the impregnations, and are stainable with that vital dye. The Golgi elements are certainly lipoidal (fat-like), whereas the vacuoles represent an aqueous material of a non-lipoidal and non-fatty nature.

I desire to pay tribute to the brilliant researches of Prof. Parat and his collaborators who have focused attention on a hitherto neglected cytoplasmic component, the vacuome, which in oogenesis may give rise to albuminous yolk as in *Perca*, *Pygosteus*, and *Ophiocephalus*. But the vacuome is not the Golgi apparatus as claimed by the Parat school. The classical Golgi apparatus may often be vesicular or vacuolar in form as in so many eggs (Nath, Gresson, etc., etc.) and even in other cells, for example, Protozoa (Hirschler, *Z. Zellf.*, 1927), but chemically and functionally it is a fundamentally different material from the vacuome. The Golgi vesicle is not a mere vacuole, but is surrounded by a thick lipoidal cortex which is characteristically argentophile and osmiophile.

VISHWA NATH.

Department of Zoology,
Government College, Lahore, India,
Aug. 2.

Manner in which Flaps of various Materials fracture along their Bases.

WHILE studying the various methods in which osteoplastic flaps for exposing the brain and its membranous coverings may be formed from the human skull, my attention has been directed to the way in which fracture takes place along the bases of bone

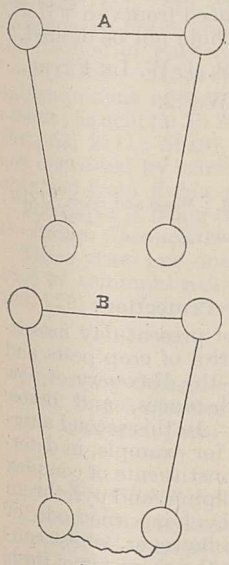

FIG. 1.

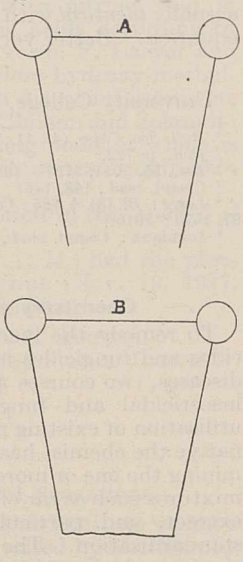

FIG. 2.

flaps. The type of fracture appears to depend upon the manner in which the limits of the proposed base line are cut.

If, by cutting three sides, a flap is fashioned so that the base lies between two trephine holes (Fig. 1, A), and the flap so formed is then bent outwards until fracture occurs along the base line, this line will be found to be jagged and irregular (Fig. 1, B). If, however, by cutting three sides, the flap is fashioned so that the base lies between saw cuts (Fig. 2, A), and the flap so formed is bent outwards until fracture occurs along the base line, this line will be found to be even and regular (Fig. 2, B). I have verified this on numerous occasions, and have also fashioned flaps from, and performed the same experiments with, other materials, such as three-ply wood, dried bone, and cardboard, and find that the results are constant in each case. The difference in the type of fracture of the base line no doubt depends upon the difference in concentration of stress at its limits.

In an article on osteoplastic craniotomy in the current number of the *British Journal of Surgery*, I have directed attention to the facts outlined here, but I believe that they may have a wider application than cranial surgery, and hence this letter.

LAMBERT ROGERS.

Welsh National School of Medicine,
The Royal Infirmary, Cardiff,
Oct. 20.

Autosyndesis among *Crepis setosa* Chromosomes.

IN a paper[1] dealing with the connexion between cytology and taxonomy, Prof. Tischler makes a statement to the effect that the four haploid chromosomes of *Crepis setosa* conjugate to form two pairs at the time of meiosis in the species hybrid *Crepis biennis* ($n=20$) × *C. setosa* ($n=4$). This he credits to us in a paper[2] in which we described a constant fertile form, *C. artificialis*, derived from these two species. Prof. Tischler also expresses doubt as to the occurrence of such a phenomenon. He says (p. 48): "Nicht dur die 20 Chromosomen der ersten Art schlossen sich autosyndetisch zu Paaren zusammen, sondern auch die 4 der zweiten. Wir erhalten so 12 Gemini. Und es ist doch die Zerlegung der vier Chromosomen in zwei einander 'homologe' Paare mehr als unwahrscheinlich."

The purpose of this letter is to direct attention to the fact that Prof. Tischler has misread our description of the origin of *Crepis artificialis*. This new species arose from a fourth generation plant of the cross between the two species *C. setosa* ($n=4$) and *C. biennis* ($n=20$). In the F_1 the 20 *biennis* chromosomes conjugate to form ten pairs while the *setosa* chromosomes remain as univalents and are distributed at random to the gametes. Thus all the F_2 progeny receive 20 *biennis* chromosomes (10 pairs) and a random number from *setosa*. *C. artificialis* arose from the union of two gametes, each of which had received 10 *biennis* chromosomes and the same two *setosa* chromosomes, thus producing a diploid complex having 20 *biennis* chromosomes (10 pairs) and 4 *setosa* chromosomes (2 pairs). Only two of the four types of *setosa* chromosomes are present in the fertile form called *Crepis artificialis*. This fact was repeatedly pointed out in the paper to which Prof. Tischler refers.

The following quotations from our original paper should be sufficient to correct the statement quoted above. "The two *setosa* chromosomes in the *artificialis* complex are quite readily recognized by their morphological characters and each is present twice. These are the first and fourth types mentioned above" (p. 309). "*Crepis biennis*, a species with 20 pairs of chromosomes, has been crossed successfully with two other species of *Crepis*, namely, *C. parviflora* Desf. and *C. rubra* L. During gamete formation in these F_1 hybrids, Mrs. Lesley found that, as in the *biennis-setosa* F_1, the 20 *biennis* chromosomes conjugate to form 10 pairs, while the chromosomes from the other

species remained as univalents and were distributed at random. We have also observed this phenomenon in a more recently made hybrid of *biennis* and *setosa*" (p. 305).

J. L. COLLINS.
LILLIAN HOLLINGSHEAD.
PRISCILLA AVERY.

[1] Tischler, G. "Verknüpfungsversuche von Zytologie und Systematik bei den Blutenpflanzen." *Bericht. Deutsch. Bot. Gesell.*, **47**, 31-49; 1929.
[2] Collins, J. L., L. Hollingshead, and P. Avery. "Interspecific hybrids in *Crepis* III. Constant fertile forms containing chromosomes derived from two species." *Genetics*, **14**, 305-320; 1929.

The Mechanism of Formation of the Latent Photographic Image.

IN 1925, with S. E. Sheppard and R. P. Loveland, I proposed the concentration speck theory of the latent image.[1] According to this hypothesis the action, during exposure, of pre-existing silver sulphide-containing specks (discovered by S. E. Sheppard [2]) on the surface of the silver halide grains of photographic emulsions, is confined to increasing their size by accretion of photochemically reduced silver atoms to form a nucleus large enough to induce developability. A mechanism of the formation of the latent image was proposed by me [3] on the basis of the experimental results of G. B. Gudden and R. Pohl on photoconductance.[4] It was supposed that the speck contains silver and silver sulphide, which, adsorbed on the surface of the silver halide crystal, form the electrodes of an elementary voltaic cell of the type $Ag/AgBr/Ag_2S$ having silver halide as the electrolyte, the external circuit being completed by contact between the silver and the silver sulphide. The growth of the speck is due to the electrolytic deposition of silver from the electrolyte.

In a recent criticism F. C. Toy and G. B. Harrison [5] regard such a theory as difficult to accept in the light of their experimental results. They point to the fact that exposure to light for a fraction of a second will normally make a photographic emulsion developable. They think that it would require an enormous increase in the voltage of the cell or a corresponding increase in the electrolytic conduction of the electrolyte to produce in this way a developable centre. This is not necessary. It is evident that the larger the speck is, below a certain limit giving spontaneous developability, the less the added number of silver atoms necessary to make the grain developable. Hence the less the exposure required for this and the greater the apparent sensitivity of the grain. They also consider that the variation of the photographic sensitivity with temperature presents a further difficulty. The sensitivity at the temperature of boiling liquid oxygen is apparently still too high to agree with an electrolytic photoconductance effect which may be expected to be vanishingly small at this temperature. This objection again ignores the effect of the size of the pre-existing speck. Only if sensitivity specks were totally absent would the temperature coefficient of photographic sensitivity be comparable with that of electrolytic photoconductance.

A. P. H. TRIVELLI.

Research Laboratories, Eastman Kodak Co.,
Rochester, N.Y., Oct. 10.

[1] *J. Franklin Inst.*, **200**, 51; 1925.
[2] "Colloid Symposium Monograph", **3**, 76; 1925. *Phot. J.*, **65**, 380; 1925.
[3] *J. Franklin Inst.*, **204**, 649; 1927. **205**, 111; 1928. NATURE, Nov. 19, 1927, **120**, p. 728.
[4] *Physik. Zeitschr.*, **22**, 529; 1921. *Zeitschr. f. Physik*, **6**, 248; 1921. **7**, 65; 1921.
[5] *Proc. Roy. Soc.*, A, **127**, 613; 1930.

Molecular Weight Determination in Camphor Solution.

IN view of the increasing use of a certain excellent and convenient procedure for the determination of molecular weights of substances cryoscopically in camphor solution, the observation should be made that the usual manner of reference to the method in our chemical journals scarcely bestows credit where it is most due.

In the year 1912 Jouniaux,[1] as a result of his "Étude de quelques mélanges binaires contenant du camphre", pointed out that "le camphre présente donc les qualités requises d'un bon solvant cryoscopique". Soon afterwards he published a paper,[2] entitled "Sur l'utilisation du camphre comme solvant cryoscopique", in which he noted the advantage that "un thermomètre ordinaire gradué en degrés" was quite satisfactory for the determinations of the necessary melting points.

In 1922 Rast,[3] without reference to previous work, suggested that the determination of melting points of solutions in camphor of about 10 per cent strength (which, unlike stronger solutions, are seen from Jouniaux's results to exhibit sharp melting points) could conveniently be made in capillary tubes in the ordinary way. This was his only essential innovation.

Rast further (without discussion) adopted 400 as the molecular lowering of freezing point for camphor, calculating this value from melting points of salol-camphor mixtures given in Landolt-Börnstein-Roth (4th edn., p. 556) which themselves are taken from a paper by Caille.[4] Jouniaux (loc. cit.) had previously deduced a higher value, namely, 498. The latter figure seems preferable, not only because camphor is known sometimes to combine with phenols,[5] but also because it is subject to an independent confirmation.[6] From van 't Hoff's relation the latent heat of fusion is seen to be 8·24 cal. Calculated from vapour pressure determinations of camphor by Ramsay and Young, Allen, and Vanstone, combined with a knowledge of the specific volumes of camphor in the liquid and solid states, a value of the latent heat of fusion is obtained actually *identical* with that deduced from van 't Hoff's equation. Better verification could not be desired.

R. J. W. LE FÈVRE.

University College, London, W.C.2.

[1] *Bull. Soc. Chim.* (4), **11**, 546; 1912.
[2] *Ibid.*, p. 722.
[3] *Ber.*, **55**, 1051, 3727; 1922.
[4] *Compt. rend.*, **148**, 1461; 1909.
[5] Leger: *Bl.* (3), **4**, 725; Caille: loc. cit.; Wood and Scott: *J.C.S.*, **97**, 1573; 1910.
[6] Jouniaux: *Compt. rend.*, **154**, 1593; 1912.

Chemistry and Plant Protection.

To remedy the inadequacy of present-day insecticides and fungicides in the control of crop pests and diseases, two courses are open—the discovery of new insecticidal and fungicidal substances, and better utilisation of existing materials. In this second alternative the chemist has assisted, for example, in determining the one or more active constituents of complex mixtures such as tar oils, lime sulphur, and pyrethrum extract, and particularly in evolving methods of standardisation. The biologist, however, whilst continuing to look to the chemist for the provision of fresh materials, is inclined to forget what knowledge of existing fungicides and insecticides the chemist has already provided. With painful frequency, reports of trials appear in which the materials tested are inadequately described, though knowledge of the probable active constituents and their estimation is available. By failing to employ this knowledge in his field work the biologist obtains results which, lacking

in essential details, cannot be reproduced or turned to use by other workers.

To describe a spray as "ammonium polysulphide (0·5 per cent)" without giving the composition of the ammonium polysulphide solution which was diluted 1 in 200; to give "lead arsenate, 4 lb. per 100 gallons" without particulars of the arsenic content of the paste or powder used; to state "1 per cent White oil emulsion" without giving the characteristics of the oil, are examples of this indifference on the part of the biologist. Such cases of inadequate description are to be met in almost every horticultural periodical, and even in research station reports. As the materials examined are of variable composition, the results are about as valuable as an estimate of size by the familiar method of comparison with a lump of chalk.

It is true that in some cases it is impossible to give sufficient details of composition because analytical methods are not available or our knowledge of the active constituents is insufficient. May not this be due in turn to an absence of demand on the part of the biologist for more accurate knowledge of the materials he finds of use? H. MARTIN.

South-Eastern Agricultural College,
Wye, Kent.

Synthesis of Munjisthin.

MUNJISTHIN, a dihydroxyanthraquinone carboxylic acid occurring in *Rubia tinctorum*, *Rubia sikkimensis*, and *Rubia munjistha*, has been synthesised by us in the following way:

2 chloro-6-methoxy toluene (Ullmann and Panchaud; *Annalen*, 350, 108; 1906) is condensed with phthalic anhydride in presence of aluminium chloride giving 2′ chloro-3′ methyl-4′ methoxy-benzoyl-2-benzoic acid (M.P. 202° C.), which on treatment with sulphuric acid gives 2 chloro-3 methyl-4 methoxy anthraquinone (M.P. 197° C.). On demethylation with anhydrous aluminium chloride this gives 2 chloro-3 methyl-4 hydroxy anthraquinone (M.P. 324°-325° C.). On oxidation with nitrous acid in presence of boric and sulphuric acids according to the method of Farbenfabriken vorm. F. Baeyer and Co. (D.R.P. 273341) the chloro-hydroxy-methyl-anthraquinone is converted into dioxyanthraquinone carboxylic acid (M.P. 231°) (cf. Ullmann and Schmidt: *Ber.*, 52, 2111; 1919), the melting point of which is not depressed by admixture with natural munjisthin obtained from *Rubia munjistha*.

The paper is being communicated to the *Journal of the Indian Chemical Society*.

Three years ago one of us (P. C. M.) had the pleasure of communicating to NATURE (Nov. 19, 1927, 120, 729) the "Synthesis of Rubiadin".

P. C. MITTER.
HAROGOPAL BISWAS.

University College of Science,
92 Upper Circular Road,
Calcutta, Sept. 18.

Experiments on Binaural Sensations.

IN experiments carried out in this Institute we have investigated some of the points raised by Mr. Humby in his letter published in NATURE of Nov. 1.

Differences either of intensity or of phase (time) may be concerned in binaural localisation of sound. It is true, as Mr. Humby says, that it is difficult to design apparatus for phase variation in which intensity changes are completely eliminated; on the other hand, it is possible to determine these changes, and even to balance the effect of a phase shift against that of a difference of intensity.

We have carried out experiments of this kind and find that the variation of intensity required to counterbalance the effect of a given phase (time) shift is very much larger than that which is unavoidably associated experimentally with that shift.

J. H. SHAXBY.
F. H. GAGE.

Physiology Institute,
University College of South Wales,
Newport Road, Cardiff, Nov. 4.

Liquid Drops on the Same Liquid Surface.

IN two previous papers,[1] I have mentioned that water at ordinary temperature is not a suitable liquid for forming "liquid drops floating on the same liquid surface". In August 1930, however, I observed at Den Kund (Dalhousie hills), at a height of about 1000 ft. above the sea-level, that water is quite a suitable liquid for easy formation of either primary [2] or secondary drops. The life of these drops is also found to be longer. The splashing gives easy formation of secondary drops of quite a long life. The temperature of the water was about 34° F. The surface tension of water at this temperature is 76·53 dynes per cm., and viscosity 0·0179 c.g.s. units.

L. D. MAHAJAN.

Physics Laboratory, Mohindra College,
Patiala, India, Oct. 4.

[1] (*a*) "Liquid Drops floating on the Same Liquid Surface", J. B. Seth, C. Anand, and L. D. Mahajan, *Phil. Mag.*, Feb. 1929. (*b*) "The Effect of the Surrounding Medium on the Life of Liquid Drops floating on the Same Liquid Surface", L. D. Mahajan, *Phil. Mag.*, London, 1930 (in the press).

[2] See *Phil. Mag.*, London, Seventh Series, No. 42, Feb. 1929, page 248.

Upper and Lower Palæolithic Man at Kirmington, North Lincolnshire.

As the result of recent investigations carried out by me at Kirmington, I am able to state that the uppermost or 'Brown' Boulder Clay contains flint artefacts of Upper Palæolithic types, whilst from the immediately underlying Glacial (cannon-shot) Gravels I have recovered a series of derived flint implements of Early Mousterian type. Similar implements, in a still more derived condition, I found in the shingle gravel which overlies the estuarine warp.

These observations, which I propose to describe in full at a later date, confirm the conclusions arrived at by Lamplugh and by me with regard to the sections at Danes' Dyke on Flamborough Head. The variableness of the "Brown Boulder Clay" at Kirmington might profitably be studied by geologists.

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Traces of Metals in Animal Tissues.

To the various elements referred to by Messrs. H. M. Fox and Hugh Ramage in their interesting letter published in NATURE of Nov. 1, there are three which may still be added.

Vanadium is stated to occur in considerable quantities in certain Ascidians; arsenic—sometimes in not inconsiderable amounts—is almost ubiquitous; and I have myself recently observed the unexpected presence of antimony. With regard to this last-mentioned element, I hope to publish a communication as soon as the work is completed.

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The Synthetic Activities of the Cell.*

By Prof. H. S. RAPER, C.B.E., F.R.S.

UNLIKE the chemist, the animal cell has a very limited choice of raw materials from which synthesis must start. These are the components of the common foodstuffs. When they have undergone the preliminary processes of digestion they provide in all about thirty substances which may be regarded as available for the building up of new compounds by the cell. Given these raw materials, can we in every instance indicate which is the likely starting-point for the synthesis of substances the constitution of which is known or partly known? This question must still be answered in the negative for such well-known products as cholesterol and the unconjugated acids of bile.

With the purine bases, which are components of nuclear material and therefore present in all cells, this question of indicating the probable raw material for their synthesis must also be answered in the negative, but with less emphasis than in the case of cholesterol and the bile acids. The amino acid histidine, which contains a five-membered ring similar to that found in the purine bases, is their most likely precursor on structural grounds. But we have as yet no experimental evidence that indicates clearly their origin from this amino acid in the body. Until this has been proved, it is perhaps useless to speculate as to the chemical processes involved in the transformation.

An example of a synthetic product which bears a fairly close structural relationship to two of the amino acids which are found in proteins is adrenaline. These two amino acids, phenylalanine and tyrosine, have practically the same carbon skeleton as adrenaline. Either of them might give rise to adrenaline by successive oxidation, methylation of the amino group, and loss of carbon dioxide. That a part of the necessary oxidation process can be brought about by means of an oxidising enzyme, tyrosinase, has already been demonstrated.

If, however, we consider whether a process of this kind, operating in the cells of the adrenal gland under specific conditions, gives rise to adrenaline, difficulties appear. When we remember that the oxidation of one substance may only take place if another is reduced; that a reaction taking place in one compound may only be possible when some other reaction takes place alongside it—in other words, that in the living cell there is a continuous and complex interplay of chemical reactions—then it is not surprising that the discovery of the mechanisms by which adrenaline is formed, although a simple problem at first sight, is probably in reality very complicated.

The case of thyroxine is comparable with that of adrenaline. Thyroxine is a relatively simple chemical substance which could conceivably be produced by the oxidation of diiodotyrosine. The last-named compound has recently been shown to be present in the thyroid gland and this makes the presumption that it is the mother substance of thyroxine all the stronger. Yet it has not been demonstrated either *in vitro* or *in vivo* that thyroxine may be produced from diiodotyrosine.

We may now pass on to consider a process in which the raw material is known with certainty but the chemical reactions by which the synthesis takes place are relatively obscure. I refer to the production of fat from carbohydrate. Lawes and Gilbert, in their classical experiments at Rothamsted on the fattening of farm stock, showed indubitably that animals can produce fat from starch. Since the starch is converted into glucose in the alimentary canal prior to absorption, we may consider glucose as the starting-point of the synthesis.

The most likely chemical explanation of the origin of the fatty acids is that they are built up, two carbon atoms at a time, from some simple reactive substance which is first produced by degradation of glucose. Acetaldehyde and pyruvic acid have both been suggested as probable participants in a reaction of this kind, the former condensing with itself as in the well-known aldol condensation, the latter either with acetaldehyde or with some higher aldehyde containing an even number of carbon atoms produced in the earlier stages of the reaction. By both of these methods it has been shown that *in vitro* aldehydes with an even number of carbon atoms in a straight chain can be built up step by step and these by oxidation can be readily converted into the corresponding fatty acids. Unsaturated linkages in the chain may be produced by either method, so that this requirement in the hypothetical synthetic method is also satisfied. Further, the condensation takes place in weakly alkaline solution or under the catalytic influence of certain organic bases, so that drastic treatment is not necessary to bring out the reaction. So far, this evidence for the mechanism of synthesis of the fatty acids is purely chemical and the grounds on which it can be put forward are largely chemical ones. It is known also that acetaldehyde and pyruvic acid, the intermediates postulated in this hypothesis, can be produced in the body. But there the question rests for the present so far as higher animals are concerned. When we know what the conditions are which set the process of fat synthesis going, and when we are able to reproduce them at will in animals, it may be possible to determine what are the intermediate substances concerned.

More success has been achieved by a study of the formation of fatty acids in micro-organisms. Bacteria which form butyric acid from glucose have been found to produce in addition both lactic acid and acetaldehyde. These same bacteria will also produce butyric acid from pyruvic aldol though not from aldehyde ammonia, aldol, or pyruvic acid itself. Neuberg and Arinstein, who investigated this type of fermentation, conclude that pyruvic aldol is the precursor of the butyric

* From the presidential address to Section I (Physiology) of the British Association, delivered at Bristol on Sept. 4.

acid when it is formed from carbohydrate. But it has also been shown that in this so-called butyric fermentation fatty acids containing an even number of carbon atoms higher in the series than butyric are formed, namely, hexoic and octoic acids. This makes it appear probable that the processes by which these lower members of the series of fatty acids are formed in bacterial fermentation may be the same as those by which higher members of the series are formed in animals.

The intensive study during the last few years of the processes of alcoholic fermentation and the chemical events which occur in muscular contraction has revealed such close similarities that we are becoming forced to accept the view that certain fundamental activities of the living cell, whether animal or vegetable, may be carried out by an almost identical mechanism. It may therefore be that we shall eventually discover the reactions responsible for the synthesis of fat in animals by investigating the processes by which it occurs in vegetable forms, such as bacteria or moulds.

Even if these reactions be the right ones, the problem still remains as to how they are accurately controlled within the cell. Some of the substances concerned in them are diffusible and very reactive, and we should have to explain how diffusion away from the site of reaction is prevented. To overcome difficulties of this kind it is becoming common to invoke the intervention of surface forces. There is, however, not much experimental evidence as yet which helps us to explain by such intervention the mechanism of synthetic processes even of such a simple kind as the reversal of an enzyme action.

Freundlich in his Liversidge Lecture to the Chemical Society last year described experiments on the influence of charcoal in modifying the velocity of certain reactions. These showed that the stability of a substance on a surface may be greater than in homogeneous solution under similar conditions. It must be borne in mind, however, that in these experiments very large quantities of charcoal were used compared with the amounts of the substances the equilibria of which were being studied. So much so that in the reaction in alkaline solution the bromoethylamine was practically completely adsorbed and the reaction was taking place entirely on the charcoal surface. Can one postulate such conditions during the continuous synthesis of substances in the cell, glycogen from glucose, for example? It seems to me that to explain the rapid accumulation of synthetic products such as fat or glycogen which we observe in cells, something more than a shift in the equilibrium of the reactions due to surface forces is necessary. Such a condition favouring synthesis could only operate for a time until the surface became saturated. We must therefore postulate some additional mechanism whereby the synthesised product is removed from the sphere of action, for if it diffused off the surface again it would be subject to the equilibrium conditions which are present in the solution. It may be that the arrangements in the cell are such that only small amounts of the substrate are dealt with at a time, so that complete synthesis is achieved and the synthetic product removed.

We have also to consider how the synthetic product is protected in the cell from the disruptive agencies which exist there. Arrangements for this purpose must be present, since we know that substances may accumulate in cells which contain enzymes that hydrolyse them. Whatever these arrangements are, they appear in certain instances to be closely associated with the life of the cell, for after death they cease to operate and the synthetic product is again broken down. However difficult it is to form a conception of them, it may be necessary to do so, since they must form a part of any system which is put forward to explain synthesis as a result of the intervention of surface phenomena.

We may now consider two syntheses in which there is little or no doubt about the raw materials or some of the chemical reactions involved. These are the production of glycogen and of proteins.

It has been proved that when glycogen breaks down in the liver it gives rise to glucose. Lohmann and also Barbour have succeeded in obtaining glycerol extracts of liver and muscle which hydrolyse it, but the product appears to be a trisaccharide and not glucose. No enzyme which by itself hydrolyses glycogen to glucose has yet been obtained from animal tissues. It is of interest that pancreatic and salivary amylase produce isomaltose from glycogen. These results suggest that there may be some configurational difference between glycogen and starch which accounts for their difference in behaviour with diastatic enzymes. Be that as it may, it appears natural to assume that the synthesis of glycogen from glucose in the cell is brought about by the simple reversal of a hydrolysis which may be catalysed by enzymes under appropriate conditions. These conditions have, however, not yet been realised *in vitro*. Barbour was unable to demonstrate any synthesis of glycogen from the trisaccharide produced by the muscle enzyme even in highly concentrated solutions.

This failure to obtain evidence of the synthesis of glycogen from the products of its hydrolysis makes it legitimate to consider whether we are right in adopting the orthodox view that the synthesis of glycogen from glucose in the living cell is brought about by a reversal of action of the enzyme or enzymes which hydrolyse it. There are other facts which merit consideration in any discussion of its mode of synthesis in the body. When an animal is fed liberally with glucose or fructose, it converts a part of them into glycogen in the liver. The evidence for this is indubitable. It implies, therefore, either a conversion of fructose into glucose before the condensation to glycogen occurs, or a conversion of both into some common form of hexose which then undergoes the condensation. Further, there is a considerable amount of accredited evidence that many substances not belonging to the sugar group can be converted into glucose in the animal body. Such substances, therefore, must be regarded as potential glycogen formers. Whatever the processes

may be which eventually result in the production of a hexose from these diverse substances, the most remarkable thing about them, to my mind, is that the hexose is always *d*-glucose. We have no satisfactory explanation for this striking stereochemical performance, but the facts suggest that the condensation of the two—or three—carbon units to a hexose is brought about under such specific conditions of strain that only the *d*-glucose configuration can result, much as coins must be minted in a definite mould to become currency.

A consideration of all the data which have been accumulated regarding the synthesis of glycogen makes it probable that more than the mere reversal of enzyme action is concerned. It is certain that the cells in which it occurs must be supplied with oxygen. Fletcher and Hopkins showed with muscle that its structure must be maintained, and with liver the synthesis certainly only takes place in the intact organ. Do not these facts point to the conclusion that it is only the living cell that can bring about this synthesis? And if this be so, cannot we go further and suggest that the substances from which glycogen is produced, or bodies derived from them, must first become bound up with, or at some stage form an integral part of, the living structure before they are converted into glycogen? The evidence at least suggests that some such conception of the process may not be far from the truth.

We may now pass to the consideration of the synthesis of proteins. In the early part of this century, due largely to the elegant methods introduced by Emil Fischer, rapid advances were made in our knowledge of the structure of proteins. These advances led to a picture of protein structure which has become generally accepted, namely, that the protein molecule is formed by the union of amino acids through an amide linkage.

The investigation of the structure of proteins, which are closely allied in origin, composition, and general chemical behaviour by immunological and in part by chemical methods, has taught us how intricate the mechanism must be by which they are built up. The facts brought out by the classical work of Dakin and Dale on the albumin of the duck's and hen's egg serve to exemplify this. The only chemical difference that could be shown between these two proteins was concerned with the disposition in the molecule of some of the leucine, aspartic acid, and histidine. But when used as antigens in the anaphylactic reaction they were markedly specific.

These results indicate that the chemical structure of the molecule is different in proteins which are very similar both in general chemical properties and in biological origin. They suggest that the protein molecule produced by a particular type of cell is always built up in a distinctive and, so far as we can determine, an unvarying pattern. We may deduce from this that although the general method of protein synthesis—that is to say, the mechanism by which amino acids are joined up—may be the same in all cells, yet there must be arrangements in the cell which enable only one particular, final pattern to result from the synthesis.

What are the methods by which the amino acids are caused to combine? The use of proteolytic enzymes in an attempt to bring about synthesis under conditions which have been partially successful with other substances has often been tried and nearly as often has failed. Two examples of protein synthesis by enzyme action have been described. The most acceptable of these is Taylor's production of a protamine by a glycerol extract of clam liver from the products of its complete hydrolysis. The other is the preparation of so-called plasteins from the products of the partial hydrolysis of certain proteins by pepsin. A comprehensive review of the subject of plastein formation by Wasteneys and Borsook, who have themselves made notable contributions to this problem, has led them to the belief that in this phenomenon we have a true resynthesis of protein from some of the more complex of its hydrolytic products.

Even if this be accepted as a possible explanation, it still leaves many questions regarding protein synthesis unanswered, and not the least difficult of these is the problem of how the separate amino acids are brought together to form the specific proteose substrates which one must postulate as combining—and in a definite order—to produce the particular protein which is characteristic of the cell which synthesises it.

The process by which the substance of the cell is increased, the building up of protoplasm, is one which must be closely allied to protein synthesis, since the material we call protoplasm is constituted for the greater part of amino acids, united, so far as can be ascertained, by the same sort of linkage that we find in proteins. The protoplasm of the dead cell responds to all the tests by which we identify protein, it is subject to the action of hydrolytic agents in the same way, and yields identical products when hydrolysed.

Ought we not therefore to look for some of the mechanisms of protein synthesis in the processes which operate when the living cell grows, and can we by any stretch of imagination account for this by a reversal of the action of one or more hydrolytic enzymes? It appears inconceivably difficult to do so. The extreme specificity of the reaction, which necessitates that at a given phase of the synthesis one particular amino acid and that one alone can be added as the next link in the molecule, requires such a multiplicity of enzymes and such a remarkable degree of control of their action as to be almost outside the range of probability. When we remember, however, that one of the prime attributes of life is that it is a dynamic condition, it does become possible to form a conception of protein synthesis in relation to that fact. The experiments of Willstätter and others have shown that to some extent the specificity of enzymes is accounted for by the 'carrier' with which they are associated. It is not inconceivable that a catalyst capable of bringing about the union of amino acids in the living cell and ultimately fashioning its protoplasm may be attached to or associated with a

'carrier' which, instead of having a fixed configuration, as with the enzymes that we can extract from the dead cell, has one which is continually varying, this dynamic state being characteristic of the living material of the cell.

If, further, we could assume that the variations in the configuration of the carrier were cyclic, always going through a definite series of phases, it might be possible to account for the fact that at any particular phase of the cycle the configuration would be such as to favour the synthetic union of one particular amino acid rather than any other because of its spatial arrangement. The assumption of cyclic changes in simple or complex living organisms is not new in physiology, and it is not unlikely that they occur in parts even of the cell itself.

The possibility that protein synthesis is associated with some part of the cell which is undergoing cyclic changes, and is thus alive, raises the interesting question of the site of this and possibly other syntheses, such as those of fat and glycogen. Are all parts of the cell, that is to say, both nucleus and protoplasm, to be regarded as alive in the sense I have indicated, and therefore to be considered as regions in which syntheses depending on life can be brought about?

It is necessary not to confuse the terms irritability and life. It is true that what we term irritability is usually taken to imply that the tissue which shows it is living; but taking the nerve fibre as an example, it would appear that the maintenance, for a time at least, of the irritability of protoplasm and its restoration when it has disappeared—but not irreversibly—does not require the presence of the nucleus. It may require oxygen or the presence of certain ions, but this may merely mean that the labile state of the protoplasm has been upset by the products of the cell's activity, and removal of these will restore it to its irritable condition.

We have no evidence that irritability as a manifestation of what we call life is more than the possession of extremely labile structures, sensitive to minute environmental changes. The nucleus, on the other hand, is essential to the continuous life of the cell and its growth. It appears also to determine very largely the magnitude of the respiratory processes which occur in it at rest, though not necessarily the excessive respiration observed in the recovery from functional activity. Can we therefore go so far as to say that the nucleus is the seat of those synthetic activities of the cell which appear to depend on its living character rather than on its irritability, or have we to regard the protoplasm as equally living, so that it is able to reproduce itself and in addition bring about such syntheses as those of fat and glycogen?

There is something to be said in favour of the idea that the protoplasm is not living in the sense in which the nucleus is, and therefore is less likely to be the seat of certain synthetic processes. It is, I think, quite a tenable view that protoplasm is made up, largely but not entirely, of combinations of amino acids such as we find in the proteins, and that it is synthesised by the nucleus to serve special as well as certain general requirements. These special requirements must and do vary greatly with each type of cell.

Consider the mammalian erthroblast. The principal substance in its protoplasm is the protein hæmoglobin. It is doubtful whether this cell exists except to produce hæmoglobin. When it has matured, the nucleus degenerates and disappears, leaving the red blood corpuscle. Along with this the respiratory activity of the cell practically disappears too, and there is not much discoverable in it except hæmoglobin. It is certainly now not living in the sense in which its progenitor, the erythroblast, was. Is it not reasonable to suggest, therefore, that the production of hæmoglobin as the erythroblast grows and matures is a function of the nucleus and not of the protoplasm of this cell? All semblance of further synthesis of hæmoglobin certainly disappears when the nucleus goes. The adoption of such a view does not imply that having produced the protoplasm of a cell the nucleus has nothing more to do with it. We know that in some indefinable way the nucleus in most cells controls the structure of the protoplasm and maintains its lability, but we have no knowledge as yet of the mechanism by which this is brought about.

One property of proteins, which may account in a general way for the presence of protein-like structure in protoplasm, is their buffering power. The nucleus is probably the most labile part of the cell. The chemical reactions proceeding in it may demand an environment that has to be finely controlled as regards changes in reaction or the concentration of certain ions. The protoplasm may thus serve as a protective layer between the nucleus and the external world, guarding it from changes which would otherwise terminate its existence. The known properties of the proteins, both chemical and physical, may be useful to this end, to which they are almost ideally suited.

Even if we can accept as possible the unorthodox view that the nucleus is the only living part of the cell, and is therefore the only part that can bring about syntheses which depend upon life, it does not solve our difficulties in explaining how they are achieved. It merely narrows down the possible sites in the cell in which they occur. The nucleus itself is a complex structure, and we have as yet few experimental methods for elucidating it. Most biologists would, I think, agree that the cell has arisen by a process of evolution from something simpler and eventually from non-living materials. It cannot have come as a 'bolt from the blue'. If we regard the nucleus as the only living part of the cell, then we may justly regard the protoplasm as something that has been acquired or developed in the process of evolution and is now necessary to its existence. We do not know definitely, however, of nuclear material which is living and devoid of its protoplasmic envelope unless such an arrangement is present in the bacteria. But the investigation of filterable viruses has given an indication that material possessing the

prime attribute of life, namely, the power of reproducing itself, exists possibly in simpler forms than we find in the smallest visible organisms.

If we agree that the cell has evolved from something simpler, then we might expect to find such elementary forms of life coexisting with it, did we but know how to look for them. The filterable viruses may represent such forms, and their chemical characters may resemble those that we find in the nucleus of the cell. The ability to synthesise protein may be a property which living material only acquired at a late stage of its evolution, and that property may be one which in the process of time has come to be essential for the maintenance of the complex structure of the nucleus as we see it to-day.

An Anthropometric Investigation on Twins.

THE latest contribution to the now considerable mass of literature bearing on the resemblances and differences between twins is a valuable memoir by Dr. Percy Stocks ("A Biometric Investigation of Twins and their Brothers and Sisters", *Annals of Eugenics*, vol. 4, April 1930). The tests and measurements were made during 1925–27 on twin children and their brothers and sisters in elementary and central schools of the London County Council, the ages of the children ranging from three to fifteen years. The characters considered in the present memoir—others will be dealt with later—include height; weight; length, breadth, and horizontal circumference of head; interpupillary distance; blood pressure; pulse rate; respiration rate; eye colour; hair colour; facial resemblance on an arbitrary scale of four classes; and finger-prints. The total number of children examined was 832 (392 boys and 440 girls), of whom 563 were members of twin pairs, 7 were surviving members of triplets, a few were odd twins who had a brother or sister at school, and the remainder were either siblings of twins, or pairs of siblings unconnected with twins, the latter being necessary to form a comparative group.

An investigation on such data is obviously not a simple matter. It is desired to compare (1) monozygotic twins, (2) dizygotic twins, (3) other siblings, with regard both to individual measurements (means, standard deviations, etc.) and correlations or differences between pairs. As was first pointed out recently by Dr. R. A. Fisher, the proportions of monozygotic and dizygotic twins amongst pairs of the same sex may, *if a character is normally distributed*, be estimated from the available data and the frequency distribution of differences analysed, but this does not give wholly what is wanted. Separation of monozygotic from dizygotic pairs on the basis of facial resemblance only is by no means so satisfactory as the unpractised observer might suppose: Dr. Stocks concludes (p. 81) that only about two-thirds of like-sexed twins can be at once separated by facial resemblance into two groups labelled 'identical' and 'fraternal', and even for these groups other evidence suggests that the diagnosis is really incorrect in a small proportion. The final conclusion reached is that finger-prints form the best fundamental test, with anthropometric measurements (height and head measurements) to decide doubtful cases, and definite rules are laid down for the purpose.

Assuming this analysis made, there is a further trouble due to the great range of age amongst the children observed, and differences of sex. Were the data subdivided into age and sex groups, the numbers in each group would be too few for valid comparison. This difficulty is surmounted by converting all measurements to standard age and sex, and only these converted or 'corrected' measurements are used. Further to increase the virtual numbers on which a comparison is based, by using relative deviations different measurements may be pooled together; for example, all the 'static characters', as Dr. Stocks terms them—height, the three head measurements, and interpupillary distance.

Finally, in an investigation of this kind, errors of measurement, and the errors involved in the fact that only single measurements were taken of such fluctuating characteristics as pulse and respiration rates, are of much more importance than they would be in most anthropometric investigations. To obtain information on these points and enable correction to be made, repeated observations were carried out on five individuals for fifty days. How important is this correction for errors and day-to-day variation may be seen from the fact that correlations between siblings are raised by about 90 per cent for pulse rate, 40 per cent for respiration rate, 20 to 30 per cent for blood pressure, though only by much smaller amounts of 0·25 to 2 per cent for the dimensional measures.

Making these corrections, mean correlations for the three groups work out as follows (Table XI., p. 103):

	Non-twin siblings.	Dizygotic twins.	Monozygotic twins.
Height	0·49	0·56	0·95
Head dimensions	0·45	0·45	0·83
Weight	0·38	0·46	0·94
Blood pressure	0·46	0·39	0·81
Pulse and respiration	0·27	0·39	0·86
Aggregate of 10 characters	0·42	0·47	0·85

The results suggest that correlations for non-twin siblings do not differ appreciably from those for dizygotic twins. Hereditary constitution appears to be more important in comparison with environment in regard to height and weight, rather less so in regard to head measurements, still less in regard to blood pressure, and least of all in pulse and respiration rates. Dizygotic twins are, in these data, on the whole inferior to their brothers and sisters in the physical measurements, but this is certainly not the case with monozygotic twins, except perhaps as regards weight.

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Science Medals of Great Britain, Ireland, and the Dominions.

THE absence of any connected and inclusive account of the terms of the trusts and foundations under which the science medals of Great Britain, Ireland, and the Dominions are allotted, whether also of yearly, biennial, triennial, or of longer interval of distribution, forms sufficient reason for an attempt to fill this gap by bringing together information upon the different awards. While various academies and societies, incorporated and other, have from time to time instituted gifts of this description, information regarding them is often scanty, and, moreover, is not well known. It is proposed to divide the awards in three classes: (1) General; (2) Physical and Mathematical Sciences; and (3) Biological Sciences (including Geology and Geography).

For many years, in countries where scientific studies have been pursued, the award of gold, silver, or bronze medals, at varying intervals, in recognition of notable researches, has been accepted as an honourable and tangible expression of contemporary opinion regarding their character and worth. In addition, the practice is very generally observed of allocating gifts of money—in other words, *prizes*—for work in identical fields, a course which it would be mere affectation to deny is substantially parallel in purpose with the custom of awarding medals. In any event, both methods have been practised by world-known academies and societies.

In Great Britain, compared with other countries, the award of medals for past and current achievements in science finds fuller favour, it must be confessed, than that of monetary prizes, though, it is true, medals are frequently accompanied by the gift of balances of funds associated with the respective foundations. But here, such allotments are very moderate in amount, scarcely to be considered as prizes. The British tendency is mostly in the direction of the establishment of fellowships and post-graduate endowment, whereby the pursuit of various branches of natural knowledge may be provided for, or definite research work promoted. However, no rule exists, and societies and individuals are free to consult their own dictates, and form their own opinion regarding the kind of stimulation and the quality of effort it is desired to continue or inaugurate.

Certain considerations respecting types of science medals may be referred to, though at the risk of being didactical. A well-proportioned artistic medal appeals to persons of good taste and discrimination, especially if, in appropriate manner, it denotes its aim and purpose. An example complying with this standard, executed in silver or bronze, is preferable to a medal of poor interest and intent produced in the gold medium. In one case design is paid for from available funds; in the other, gold value. What might prove a legitimate source of pleasure and pride to the recipient may be sacrificed for a gift-horse in metal, weak, or frankly ugly. There are, however, limiting difficulties which cannot be overlooked. Mixed committees charged to discuss and decide upon the institution of medals not infrequently display a regrettable lack of judgment. At the end some compromise is inevitable. Yet in the service of science, medallic art may find surviving compensations, notwithstanding these pains and penalties.

Generally it is incumbent on the artist-designer of a modern science medal to portray on his obverse the lineaments of some person whose achievements are connected with the *raison d'être* of foundation. If, in regard to the reverse, his hands are not unduly tied, symbolism, imagination, and poetic fancy have scope for exercise. The reverses of medals of earlier centuries present an infinite variety of design and device. Most of them drew inspiration, in some form or other, from Greek and Roman coins, where the figures of deities with their attributes were symbolised. They serve the designer of the science medal in that he may associate pagan derivatives with modern developments of philosophy and natural knowledge. On the reverse of the Nobel gold medals awarded for physics and chemistry, we see Nature personified as the goddess Isis. But the reverse of the gold medal struck in 1907 by the Royal Swedish Academy of Sciences to commemorate the two hundredth anniversary of the birth of Linnæus depicts a student dissecting a flower; the art here is wholly pictorial in conception.

An authoritative critic has remarked that "more than anything else, the medal in its restrained limits, proves that art has nothing to do with mere quantities, and that within the small circle of a disc of metal the great artist can make his appeal as unerringly and as powerfully as upon square yards of canvas". It is in chief to French artists, working during the period since 1870, that we owe much that is in agreement with the foregoing comment. The medals of David, Chaplain, Dubois, and Roty commemorate men and women and signalise great events after the fashion of the traditions of the early Italian and German designers, and over and above is fancy and charm of detail. The late M. Roty stood at the head of

these artists. In a letter which the writer received from him in 1898 he says: "The rectangular form of medal was only adopted a few years ago. I was the first to re-employ this form, and it was so successful that my colleagues in France and in other countries followed my example. The habits of sheep are very much the same in all countries." The well-known rectangular plaquette of Pasteur was by M. Roty.

Medals of satirical implication, designed to provoke ridicule, were in circulation at the end of the sixteenth and throughout the seventeenth centuries. In the most part they bore reference to current and acute political and religious controversies, and hence do not concern us here. But it is worthy of note that science does not appear to have suffered from the satire of the die-sinker. Even at the time of Jenner's discoveries, though many lampoons and caricatures deriding the smallpox preventative were published, no satirical medal was issued.

In the preparation of modern medals the usual procedure of the artist-designer is to make a model in modelling wax on slate, to scale. From this a cast in plaster is taken, which may be worked over and serve as the final model. Bronze casts can now be obtained by the expert founders. If a struck medal is required, a cast in steel is made from the plaster model, and from it convex dies in soft steel are produced by the 'reducing machine'; after hardening, they serve then their mission, which is to punch out the concave dies for striking the medal.

Reference was made recently in this journal (Oct. 5, 1929, p. 557) to the observation of Gurwitsch that when the tip of one actively growing onion is brought near to the tip of another growing onion, whether end-on or broadside-on, mitosis is stimulated in the latter in the neighbourhood of the growing tip of the former; from which is deduced or foreshadowed an attractive hypothesis of biological rays and fields of force, a counterpart of the fields of force of physical science. Can it be that the medallic art of a distant future will have to consider the onion seriously; that whereas we already have *Primula* and *Nepenthes* (Darwin medal, Royal Society), a future designer may have to include *Allium* in his list of possible delineations?

I. General.

Royal Society of London.

Copley Gold Medal.—Founded in 1736, arising from a legacy derived in 1709 from Sir Godfrey Copley, Bart., F.R.S., and for some time used otherwise than in medallic gifts. Bestowed annually upon the living author of such philosophical research, either published or communicated to the Society, as may appear to the council to be deserving of that honour. No distinction of nationality governs allotment.

Royal Medals.—Two gold medals were founded by King George IV., the grants being continued by successive sovereigns. They are awarded annually (subject to royal approval) for the two most important contributions to the advancement of natural knowledge, published originally in His Majesty's dominions within a period of not more than ten years, and of not less than one year of the date of the award. The obverse of each medal bears the head of the reigning sovereign.

See, for other medals awarded by the Society, Physical and Mathematical Sciences and Biological Sciences sections.

British Association for the Advancement of Science.

Montreal Medal.—During the Montreal meeting (1884), the decision was taken to commemorate the visit by founding a bronze medal for annual award by McGill University for proficiency in applied sciences. The obverse bears the head of James Watt.

Toronto Medal.—From the income of a fund raised by members who attended the meeting (1924), two bronze medals and gifts of books are awarded annually to selected students of the University of Toronto.

South Africa Medal.—To commemorate the visit (1905), a fund was raised among the members who made the journey for the provision and endowment of a medal or studentship for South African students. The medal was struck in bronze from designs by Mr. Frank Bowcher. The symbolical figure on the reverse has since served the Association as a badge.

Following upon the meeting in South Africa in 1929, a medal for scientific workers in South Africa not exceeding thirty years of age has been instituted, under an arrangement between the British and South African Associations.

Asiatic Society of Bengal.

Sir William Jones Memorial Medal.—Awarded biennially for Asiatic researches in science. The next award falls due in 1931.

See also Biological Sciences section.

Royal Society of Canada, Ottawa.

Flavelle Gold Medal.—The gift of Sir Joseph Flavelle of Toronto, and first awarded in 1925. It is allotted to fellows of the Society or others for original work in science or literature of especial merit. The medal is not necessarily bestowed annually. Since 1927 it has been awarded only for work in science.

Royal Society of Edinburgh.

Keith Gold Medal.—Instituted in 1820, and awarded biennially, together with a sum of money from the fund, for the most important discoveries in science made in any part of the world, but communicated by their author to the Society, and published first in its *Transactions*. In 1833 provision was made, during any biennial period, for a substantive mode in adjudication. The medal bears the bust of John Napier on the obverse.

Makdougall-Brisbane Gold Medal.—Instituted in 1855 by Sir Thomas Makdougall, Bart., president, 1832–60, and awarded biennially, together with a sum of money from the fund, to such person, for such purposes, for such objects, and in such manner as shall appear to the council most conducive to the promotion of the interests of science. For 1930–31 the medal (and prize) will be awarded for an essay, paper, or other work having reference to any branch of scientific inquiry, either material or mental. Open to all men of science. The obverse of the medal bears the head of the founder.

See also Biological Sciences section.

Royal Irish Academy

Cunningham Gold Medal.—Instituted under the bequest (1789) of Timothy Cunningham, of Gray's Inn, and first awarded in 1796. Medals have not been allotted since 1885, the interest of the fund having been devoted to the publication of memoirs. The head of Lord Charlemont, first president of the Royal Irish Academy, appears on the obverse of the medal.

Royal Society of Tasmania.

Society's Medal.—Founded in 1927 for the recognition of eminence in research, and for work of outstanding merit on behalf of the Society and the State. Awarded at intervals (irrespective of sex). The regulations are restrictive as regards residence in Tasmania and membership of the Society. The medal is oval in shape, and is struck in bronze.

African Society.

Society's Gold Medal.—Founded in 1920 by Mr. Henry S. Wellcome, a member of council, for annual award, in respect of eminent services rendered to Africa. A silver medal was also instituted by him at the same time in recognition of kindred services. The medals are in memorial of Mary Kingsley. The first recipient was Sir Harry Johnston.

Royal Institute of British Architects.

Grissell Gold Medal.—Awarded annually for meritorious work in constructive architecture.

The Institute has a series of medals at its disposal for the encouragement of various branches of architecture. We select one which bears relation to questions mutually concerning the architect and man of science.

Royal Society of Arts.

Albert Medal.—Instituted in 1862 as a memorial of H.R.H. the Prince Consort. Struck in gold, it is awarded for "distinguished merit in promoting Arts, Manufactures, and Commerce". The first bestowal was made in 1864 to Sir Rowland Hill, and annually since, irrespective of the nationality of the recipient. The obverse bears the head of the Prince Consort.

The Society also awards annually ten or twelve silver medals for the best papers read during the session.

Royal Scottish Society of Arts.

Keith Medal.—The Keith Prize was founded in 1833 by Alexander Keith, to be applied in sums of money or medals in rewarding inventions, improvements, or discoveries in the useful arts. The award frequently consists of a medal together with a sum of money.

Brisbane Medal.—The Brisbane Prize was instituted in 1856 by Sir Thomas Makdougall-Brisbane, Bart., to be awarded either in a medal or a medal along with plate, books, or money, to the authors (or inventors) of communications of merit.

Hepburn Medal.—The Hepburn Prize was founded in 1862 by John Stewart Hepburn, for inventions and communications approved by the Society. The award (annual or biennial) frequently consists of a medal together with a sum of money.

Society's Medal.—Awarded at the discretion of the council as a means of recognising special services rendered to the Society, or in such other manner as the Society may approve. The medals may be struck either in gold, silver, or bronze.

Royal Asiatic Society of Great Britain and Ireland.

Society's Gold Medal.—Instituted in 1897 to commemorate the sixtieth year of reign of Queen Victoria. Awarded triennially in recognition of distinguished services in Oriental research.

Burton Memorial Medal.—Instituted in 1925 to celebrate the birth centenary of Sir Richard F. Burton. Awarded triennially in connexion with a lecture dealing with the life of Burton, and his contributions to Oriental literature and studies of Eastern life and character. Also in respect of his explorations and travels and geographical achievements, or those of other famous explorers whose travels have led to an increase of geographical and ethnological knowledge. The medal is struck in silver; the obverse bears the head of Burton.

Royal Empire Society (formerly Royal Colonial Institute).

Society's Gold Medal.—First awarded in 1914 for a monograph on an Imperial subject. After 1915 the gift fell into abeyance during the remaining period of the War. On its revival in 1925, it was decided to award the medal for the work adjudged to be the best recent book on a subject of Imperial interest.

Royal Society of Literature.

Society's Gold Medal.—The Society was founded by George IV. in 1823, and incorporated in 1825. The first award of a medal was made in 1825 and bestowed upon James Rennell, F.R.S., the geographer. Awards are made at varying intervals. The obverse of the medal bears the head of George IV.

Royal United Service Institution.

Institution Gold Medal.—Founded in 1874, and awarded annually for the best essay on a naval and military subject alternately. The obverse bears the head of Athena.

Chesney Memorial Gold Medal.—Founded in

1900, and awarded at intervals to "the author of any specially eminent work calculated to advance military science or knowledge in the Empire". The medal was instituted to commemorate the services of General Sir George T. Chesney, K.C.B., R.E.

Chester Society of Natural Science, Literature, and Art.

Kingsley Memorial Medal.—Founded in 1877, and awarded "for having contributed materially to the promotion and advancement of some branch or department of Natural Science". The medal commemorates the Rev. Charles Kingsley, founder of the Society. The medal is struck in bronze, and bestowed annually. The obverse bears the head of Kingsley.

Victoria Institute, or Philosophical Society of Great Britain.

Langhorne Orchard Prize.—A silver medal for a prize essay on a subject bearing on science and religion. First given in 1925 and again in 1929. An open Bible is inscribed on one side of the medal.

II. Physical and Mathematical Sciences.

Royal Society of London.

Rumford Gold Medal.—Founded in 1796 by Count Rumford, F.R.S., and first awarded in 1800. Bestowed biennially upon the author of the most important discovery or useful improvement in heat or light during the preceding two years. The medal is also struck in silver; the obverse bears the head of Rumford.

Davy Gold Medal.—Founded in 1869 under the will of Dr. John Davy, a brother of Sir Humphry Davy. Awarded annually for the most important discovery in chemistry made in Europe or Anglo-America. The obverse bears the bust of Davy.

Sylvester Medal.—Awarded triennially for the encouragement of mathematical research, irrespective of nationality, and in honour of the life-work of Prof. J. J. Sylvester, F.R.S. First allotted in 1901. The medal is struck in bronze; the obverse bears the bust of Sylvester.

Hughes Gold Medal.—Founded under the will of Prof. D. E. Hughes, F.R.S., who died in 1900. Awarded annually for original discovery in the physical sciences, particularly electricity and magnetism, or their applications. The medal is allotted without restriction of sex or nationality; the obverse bears the head of Hughes.

See also General and Biological Sciences sections.

Royal Dublin Society.

Boyle Medals.—Founded in 1895, and awarded on the recommendation of the Committee of Science and its Industrial Applications in recognition of scientific work of outstanding merit done by Irishmen, or in Ireland, and not restricted to members. The medals are struck in bronze; the obverse bears the head of Robert Boyle from a bust of him in the possession of the Society. Two medals may be awarded annually, but in practice bestowals occur at irregular intervals.

New Zealand Institute, Wellington.

Hector Memorial Medal.—Founded in 1912 in honour of Sir James Hector, F.R.S., in association with a Hector Research Fund. The medal is struck in bronze, and bestowed annually in rotation for the following subjects: botany, chemistry, ethnology, geology, physics (including mathematics and astronomy), zoology (including animal physiology). Awarded to that investigator who, working within the Dominion of New Zealand, shall have done most towards the advancement of that (allotted) branch of science. In 1916, Sir Ernest Rutherford received the medal for researches in physics.

Royal Aeronautical Society.

Simms Gold Medal.—Awarded annually for the best paper read in any year before the Society on any science allied to aeronautics, for example, meteorology, wireless telegraphy, instruments. Allotted to a member or non-member.

Taylor Gold Medal.—Awarded annually for the most valuable paper submitted or read during the previous session before the Society. Allotted to a member or non-member.

Sir Charles Wakefield Gold Medal.—Awarded annually to the designer of any invention or apparatus tending towards safety in flying.

Society's Silver Medal.—Awarded at the discretion of the council, for some advance in aeronautical design. Allotted to a member or non-member.

Society's Bronze Medal.—Awarded under the same conditions as those for the silver medal, but for some less important advance in aeronautical design.

Royal Astronomical Society.

Society's Gold Medal.—Instituted in 1823, it was first awarded in 1824 to Babbage in respect of his calculating machine; also to Encke for his determination of the elliptic orbit of Encke's comet. Awarded annually, as may be expedient, for discovery in astronomy or research in the science. The obverse bears the bust of Newton.

Jackson-Gwilt Medal.—Arising from a personal fund established in 1861, the first award came up for allotment in 1897. Struck in bronze, it is bestowed at intervals of not less than three nor more than seven years, and for the promotion of astronomy. The obverse bears the bust of William Herschel.

Institution of Naval Architects.

Institution's Gold Medal.—Awarded annually by the council to any person (not being a member of

that body) who communicates a paper deemed to be of exceptional merit. The gift was established in 1877.

Chemical Society.

Faraday Medal.—Instituted in 1868 in connexion with the establishment of a Faraday lectureship, and usually awarded to foreigners. Struck in bronze, and bestowed at varying intervals. The obverse bears the head of Michael Faraday. The first award was made to Dumas in 1869.

Longstaff Medal.—Instituted in 1881 in connexion with a donation for research work in chemistry, provided by Dr. G. D. Longstaff. Awarded triennially. It is struck in bronze, and the obverse bears a portrait of Longstaff.

Harrison Memorial Prize.—In 1922 the Society established a memorial fund derived from friends and colleagues of Colonel Edward Frank Harrison, Deputy Controller of the Chemical Warfare Department during the War, having for application a triennial prize for the most meritorious and promising original investigations in chemistry by a natural-born British subject of either sex. A bronze medal allotted with the gift reproduces in scale the Society's War Memorial plaque.

Institution of Chemical Engineers.

Osborne Reynolds Medal.—Founded in 1928, the gift of Mr. F. A. Green. Awarded annually for meritorious work accomplished for the advancement of the Institution. The medal is struck in silver.

Moulton Gold Medal. — Founded in 1929. Awarded annually for the best chemical engineering paper of the year "of a mature character", read before the Institution and published in the *Transactions*. Awards may be made to non-members. The obverse bears the head of Lord Moulton.

Society of Chemical Industry.

Society's Gold Medal.—Awarded biennially by the Society for conspicuous services to applied chemistry, by research, discovery, invention, or improvements, or to the Society in the furtherance of its objects. The recipient may be of any nationality, and not necessarily a member. The medal was first presented in 1896.

Messel Memorial Medal.—A gold medal (with an honorarium) is awarded biennially, and commemorates Dr. Rudolph Messel, F.R.S., an original member and benefactor of the Society. The medal is allotted for special distinction in science, literature, or public affairs. The obverse bears the head of Dr. Messel. The first award was made in 1922.

Institute of Chemistry of Great Britain and Ireland.

Meldola Medal.—Founded in 1921, the gift of the Society of Maccabæans. Awarded annually to the chemist "whose published chemical work, issued within the year prior to bestowal, shows the most promise". The recipient must be a British subject not more than thirty years of age at the time of the completion of the work. The medal is struck in bronze: the obverse bears the bust of Raphael Meldola, F.R.S.

Frankland Medal.—Founded in 1927, on the occasion of the jubilee of the Institute, as a memorial to the first president, Sir Edward Frankland, F.R.S. The medal is awarded annually, and is struck in bronze; the obverse bears the bust of Frankland.

Society of Dyers and Colourists, Bradford.

Perkin Gold Medal.—Instituted in 1908 in honour of Sir William Perkin, president in 1907, and awarded at intervals of two or three years for discoveries or work of outstanding importance in connexion with the tinctorial arts. The obverse bears the bust of Perkin, which was modelled by F. W. Pomeroy, R.A.

Dyers' Company's Gold Research Medal.—Instituted in 1908 and awarded annually for a paper submitted to and published by the Society of Dyers and Colourists in the year, embodying the results of scientific research or technical investigations connected with the tinctorial art.

The Society's Medal.—Instituted in 1908, and awarded occasionally in recognition of work of exceptional merit carried out under the Society's Research Scheme. It may be struck either in gold, silver, or bronze.

Manchester Association of Engineers.

Constantine Gold Medal.—First awarded for the year 1903–4, and annually since then. The gift was established by Mr. E. G. Constantine, a past president of the Association, with the object of encouraging papers containing original or other matter conveying the most useful information to the Association upon the practice and theory of engineering. The medal may be allotted to non-members of the Association.

Society of Engineers.

President's Gold Medal.—Awarded annually by the president, through the council, for a paper on a subject of general interest connected with engineering. Instituted in 1886. The obverse bears the Society's seal; the reverse is engraved with particulars of the paper which secured the gift, the names of the author and the president who awarded the medal, with the date.

Institution of Engineers and Shipbuilders in Scotland.

Railway Engineering Gold Medal.—Founded in 1865, and awarded annually for communications in railway engineering and practice.

Marine Engineering Gold Medal.—Instituted in 1865, and awarded annually for communications on subjects in marine engineering.

Institution Gold Medal.—Founded in 1865, and awarded annually for subjects not within the scope of the railway and marine engineering medals.

The obverses of these medals bear the bust of James Watt.

Engineering Institute of Canada.

The Institute awards four medals, named respectively the *Gzowski*, *Kennedy*, *Leonard*, and *Plummer*, each concerned with some aspect of engineering science.

Institution of Civil Engineers.

Telford Gold Medal.—The question of instituting a medal to be awarded for meritorious memoirs was considered in 1827. Thomas Telford, F.R.S., the first president, died in 1834, and through a bequest made by him for the provision of annual premiums, the Institution's Telford medal was bestowed in 1837, and annually since. The award is not limited to papers on any particular subject or subjects. The obverse of the medal bears the head of Telford.

James Watt Gold Medal.—Founded in 1858 and awarded to the author or authors of a paper on any engineering subject, usually one dealing with mechanical engineering. The obverse bears the bust of Watt.

George Stephenson Gold Medal.—Founded in 1881 for award to the author or authors of a paper on any engineering subject. The obverse bears the head of Stephenson.

Kelvin Gold Medal.—In 1913 a memorial window was placed in Westminster Abbey on behalf of the engineers of the British Empire and of the United States of America. A portion of the memorial fund was made available for the founding of a Kelvin gold medal for triennial award for distinction in engineering work or investigation of the character with which Lord Kelvin was especially identified. The first bestowal was made in 1920. The obverse bears the bust of Lord Kelvin.

N.B.—The Institution of Civil Engineers acts as an administrative body, the award of the medal being in the hands of a committee, consisting of the presidents for the time being of eight of the leading engineering institutions in Great Britain, which considers recommendations.

Coopers Hill War Memorial Medal.—Founded in 1921 by the Coopers Hill Society, in memory of its members and relatives of members who fell in the War. In the annual award of the Institution of Civil Engineers, and allotted to the author of the best paper for a selected professional subject. The medal is struck in bronze.

Howard Gold Medal.—Founded in 1927. For quinquennial award to the author of a treatise on any of the uses or properties of iron, or to the inventor of some new and valuable process relating thereto. The first bestowal was made in 1927 as part of the Howard Quinquennial Prize awarded since.

Institution of Electrical Engineers.

Faraday Medal.—Founded in 1921 to commemorate the fiftieth anniversary of the first ordinary meeting of the Society of Telegraph Engineers (now the Institution of Electrical Engineers). Awarded annually, either for notable scientific or industrial achievement in electrical engineering, or for conspicuous service rendered to the advancement of electrical science, without restrictions as regards nationality, domicile, or membership of the Institution. Struck in bronze, the obverse bears the head of Michael Faraday.

Coopers Hill War Memorial Medal.—Founded in 1921 by members of the Royal Indian Engineering College, Coopers Hill, and awarded annually by the Institution of Civil Engineers and triennially in turn by the Institution of Electrical Engineers, the School of Military Engineering, Chatham, and the School of Forestry, Oxford. The medal is struck in bronze.

Willans Gold Medal.—Founded in 1895 by subscription, and awarded triennially alternately by the Institution and the Institution of Mechanical Engineers, for the best paper dealing with the utilisation and transformation of energy, treated especially from the point of view of efficiency or economy. The obverse of the medal bears the head of Peter William Willans. The first award was made in 1897, and by the Institution of Electrical Engineers.

Institution of Gas Engineers.

Birmingham Gold Medal.—Founded in 1881 by funds received from the gas undertakings and companies, gas engineers and managers, and constructors of gas plant in the Birmingham area. It is awarded at the discretion of the council for "Originality in connection with the manufacture and application of gas", such qualification to be interpreted in its widest possible sense. Allotted at intervals of not less than two years, without distinction of nationality.

H. E. Jones, London, Gold Medal.—Founded in 1905 by the late Mr. H. E. Jones, a past president of the Institution, and bestowed annually. It is awarded for the best contribution dealing with "The principles involved in the construction of works or plant for the manufacture or distribution of gas. . . . The points of good management of a gas undertaking considered in relation to the management of labour, and popularising the use of gas for general purposes, or improvement in carbonising and purifying processes, or in the development of residuals."

Institution Gold Medal.—Awarded at the discretion of the council, at varying intervals, to the author of a paper read at a meeting of the Institution which is considered worthy of such recognition.

Institute of Marine Engineers.

Denny Gold Medal.—Founded in 1891 and offered annually for a paper of merit by a member. The head of the founder, Mr. Peter Denny, appears on the obverse.

Institute's Silver Medal.—Founded in 1922, and is awarded annually for a paper of merit read by a non-member.

Institution of Mechanical Engineers.

Thomas Hawksley Gold Medal.—Founded in 1914, arising from a fund established by Mr. Thomas Hawksley, to perpetuate the memory of Thomas Hawksley, F.R.S., twice president of the Institu-

tion. Awarded annually for the best original paper read at a general meeting of the Institution or printed in the *Proceedings* during the preceding year.

Willans Gold Medal.—Founded in 1895 by subscription and awarded triennially by the Institution and the Institution of Electrical Engineers for the best paper dealing with the utilisation and transformation of energy, treated especially from the point of view of efficiency or economy. The obverse of the medal bears the head of Peter William Willans. The first award was made in 1897, and by the Institution of Electrical Engineers.

Institution of Water Engineers.

Whitaker Medal.—Founded in 1927, through a fund placed at the disposal of the Institution by a member (desiring to remain anonymous), the interest on which to be used for a bronze medal to be given annually to the author of the best paper each year dealing with the application of geology to water engineering. The donor intended that the gift should be not only a stimulus and encouragement to research, but should also tend to memorialise the late William Whitaker, F.R.S., the eminent geologist. The obverse bears the head of Whitaker, from the rendering of Mr. Frank Bowcher. The first award was made in 1930 for a paper by Mr. R. C. S. Walters on "The Hydrogeology of the Chalk of England".

Institute of British Foundrymen.

Oliver Stubbs Gold Medal.—Established in 1921 by the National Ironfounding Employers' Federation and presented to the Institute to encourage and reward efforts made by its members to impart knowledge on the practice and theory of founding. Awarded annually. The obverse bears the head of Oliver Stubbs.

Iron and Steel Institute.

Bessemer Gold Medal.—Founded in 1873 by Mr. (afterwards Sir Henry) Bessemer, and awarded annually for distinguished merit in promoting the metallurgy of iron and steel.

Andrew Carnegie Gold Medal.—Founded in 1901 by Mr. Carnegie. It is awarded to the author of the paper considered to be the most meritorious of those presented in any one year. The award of this medal remained in abeyance during the War, and for some years afterwards; in 1927 the reports of research work submitted within the previous thirteen years were considered, and three awards were made. Since 1927 no further award has been made. The obverse of the medal bears the bust of Andrew Carnegie.

Gold Medal of the Blacksmiths' Company, City of London.—An offer by the Court to award annually a gold medal bearing the arms of the Company was accepted in 1919. It was agreed that the council of the Iron and Steel Institute should recommend every year the name of a member for the award, preference being given (other things being equal) to members who were or had been students or apprentices practically engaged in the working or the manufacturing of iron or steel, or had achieved work of merit or importance in connexion with the manufacture of iron and steel. The first award was made in 1920.

London Mathematical Society.

De Morgan Gold Medal.—Following the death of Prof. A. De Morgan, in 1871, it was decided to establish a medal in trust for the advancement of mathematical science, and as a memorial of the Society's first president. The gift is of triennial allocation, open to mathematicians of all countries, and is not restricted to any particular branch of mathematical study. The die was entrusted to Thomas Woolner, R.A., and the bust of De Morgan appears on the obverse of the medal. The first award was made in 1884 to Prof. A. Cayley.

Royal Meteorological Society.

Symons Gold Medal.—Founded in 1901, and awarded biennially for distinguished work done in connexion with meteorological science, irrespective of sex or nationality. The obverse of this memorial medal bears the head of G. J. Symons, F.R.S., founder of the British Rainfall Organization.

Institution of Mining and Metallurgy.

Institution Gold Medal.—Founded in 1902, and awarded annually for conspicuous services in the advancement of the science and practice of mining or metallurgy.

Canadian Institute of Mining and Metallurgy.

Leonard Gold Medal.—Awarded annually, through a fund established by Lieut.-Col. R. W. Leonard, for the best paper on a mining subject, communicated either to the Engineering Institute of Canada or to the Canadian Institute, and open to all classes of members of either body.

Randolph Bruce Gold Medal.—An annual award for the most notable contribution in the field of practical mining, metallurgy, or geology, to the advance of the mining industry of Canada. Provision has been made (1929) by His Honour R. Randolph Bruce, Lieutenant-Governor of British Columbia, for the successive award to members of the Institute of ten gold medals.

North of England Institute of Mining and Mechanical Engineers, Newcastle-on-Tyne.

Greenwell Medal.—Awarded either in gold, silver, or bronze, at the option of the council of the Institute, to the writer of a paper recording the results of experience of interest in mining, and especially where deductions and practical suggestions are made by the writer for the avoidance of accidents in mines. The medal is provided out of a fund of £100 given by the late Mr. G. C. Greenwell in 1900. The head of the donor appears on the obverse of the medal.

Institution of Petroleum Technologists.

Boverton Redwood Medal.—In 1921, Mr. A. Duckham expressed a wish to establish such gift

to commemorate the late Sir Boverton Redwood, founder of the Institution, and its first president. The award is biennial, and for a paper or papers deemed to advance knowledge of the technology of petroleum. The council decided in 1924 that in the first instance papers should be considered from so far back as 1919, the year following the War. Accordingly the first award, as for 1919–21, was made to M. Paul Chambrier, who described the revised method of working the petroleum deposits at Pechelbronn, Alsace. The medal is struck in bronze, and allotted irrespective of nationality. The head of Redwood appears on the obverse.

Manchester Literary and Philosophical Society.

Dalton Medal.—Founded in 1864, but the first award was not made until 1898, the medal being adopted "for presentation on such occasions as the Society may determine". The last recipient (1919) was Sir Ernest Rutherford. The obverse bears the head of John Dalton. The medal is struck in bronze.

Royal Philosophical Society of Glasgow.

Graham Gold Medal.—Founded in 1878. Candidates for the award are required to enter a paper giving an account of an unpublished original research in any branch of chemical science, pure or applied. The medal is allotted for the particular research considered of the highest merit and most likely to aid in the advancement of chemical science. The award may take the form, as desired, of (1) the medal in gold; (2) the medal in bronze and scientific instruments or books; (3) the medal in bronze and the balance of the fund for application in chemical research. The obverse of the medal bears the bust of Thomas Graham, with the date of his birth and death. (This medal has not been allotted for some years. The original fund provided also for special lectures in chemistry, and the whole income is now made available mainly for the purpose of the "Graham Lectures".)

Royal Photographic Society of Great Britain.

Exhibition Medal.—First awarded in 1877, twenty-four years after the Society's Exhibition was inaugurated. The medal is struck in bronze. The obverse bears the head of H.R.H. the Prince Consort.

Progress Medal.—Founded in 1878. Awarded in recognition of any invention, research, publication, or exhibition which, in the opinion of the council, shall have resulted in any important advance in the development of photography. The medal is struck in silver.

John Traill Taylor Memorial Medal.—Instituted in 1898, and struck in bronze, the medal is bestowed in association with a memorial lecture. The obverse bears the bust of Taylor.

Hunter and Driffield Memorial Medal.—Instituted in 1920, and struck in silver, the medal is bestowed in association with a memorial lecture.

Physical Society of London.

Duddell Medal.—Founded in 1922 as a memorial of William Duddell, F.R.S., and awarded annually, irrespective of nationality and sex, for contributions to the advancement of knowledge by the invention or design of scientific instruments, or by the discovery of material used in their construction. The medal is struck in bronze; the obverse bears the bust of Duddell.

Institution of the Rubber Industry.

Colwyn Gold Medal.—Established through a gift made by Lord Colwyn, and first awarded in 1928. It is allotted annually for conspicuous services of a scientific or technical character, bearing on the improvement or development of rubber manufacture or production. The recipient must be a British subject. The obverse of the medal bears the bust of Lord Colwyn.

Royal Statistical Society.

Howard Medal.—Instituted in 1873, and bestowed upon the author of an essay on some branch of social statistics, selected by the council. The medal is struck in bronze, and competition is not limited to fellows of the Society. The obverse bears the bust of John Howard, F.R.S.

Guy Medal.—Instituted in 1891 in honour of Dr. William A. Guy, F.R.S. Awards are confined to fellows of the Society, and to those who are adjudged to merit distinction on account of original contributions to the theory or practical applications of statistics. The medal may be of gold, silver, or bronze. The obverse bears the bust of Guy.

III. Biological Sciences (including Geology and Geography).

Royal Society of London.

Darwin Medal.—Arising from the transfer in 1885 of an International Darwin Memorial Fund, a silver medal is awarded biennially in recognition of work of acknowledged distinction (especially in biology) in the field in which Charles Darwin himself laboured. The obverse bears the bust of Darwin. Bestowal may be made without distinction of nationality or sex. First awarded in 1890.

Buchanan Gold Medal.—Awarded quinquennially in respect of distinguished services to hygienic science or practice in the direction either of original research or of professional, administrative, or constructive work. Bestowal may be made without distinction of nationality or sex. First awarded in 1897. The obverse bears the head of Sir George Buchanan, F.R.S.

See also General and Physical and Mathematical Sciences sections.

Asiatic Society of Bengal.

Barclay Memorial Medal.—Awarded biennially for conspicuously important contributions to medical

or biological science with reference to India. The next award falls due in 1931.

Annandale Memorial Medal.—Awarded triennially for important contributions to the study of anthropology in Asia. The next award falls due in 1931.

Joy Gobind Law Memorial Medal.—Founded in 1929 by Dr. Satya Churn Law, and for triennial award for conspicuously important work on zoology in Asia. The first award was made in February 1930.

Paul Brühl Memorial Medal.—Instituted in 1929 through funds provided by the "Brühl Farewell Committee". To be bestowed triennially for meritorious researches in Indian botany, in commemoration of the life-work of Prof. Paul J. Brühl, a teacher of botany in India, chiefly in Calcutta. The first award will be made in 1932.

See also General section.

Australian Association for the Advancement of Science.

Mueller Memorial Medal.—In 1902 the Association accepted a fund in the hands of the Mueller National Memorial Committee with the view of founding a medal in memory of Baron Sir Ferdinand von Mueller, long identified with research work in natural science in Australia. The interest of the fund is allocated for a bronze medal, awarded biennially to the author of important contributions to anthropological, botanical, geological, or zoological science, published originally within His Majesty's dominions, preference being always given to work having special reference to Australasia. A money gift may be allotted with the medal. Rectangular in shape, the obverse bears a quarter-length presentment of von Mueller.

Royal Society of Edinburgh.

Neill Gold Medal.—Instituted in 1851, and awarded biennially or triennially, together with a sum of money from the fund, for a paper of distinguished merit on a subject of natural history, by a Scottish naturalist, presented to the Society during the period; or it may be awarded for a work or publication by some distinguished Scottish naturalist in some branch of natural history, bearing date within five years of the time of award. The obverse of the medal bears the head of Patrick Neill, LL.D.

Bruce Medal.—Instituted in 1923 to commemorate the work of Dr. W. S. Bruce as an explorer and scientific investigator in polar regions. Open to workers of all nationalities, with a preference for those of Scottish birth or origin. Awarded biennially, in bronze, with a sum of money, for some notable contribution to the natural sciences; to be in the nature of new knowledge, the outcome of a personal visit to polar regions on the part of the recipient. The Royal Physical Society, Edinburgh, and the Royal Scottish Geographical Society assist in the allotment.

See also General section.

Royal Society of New South Wales, Sydney.

Clarke Medal.—The Society was inaugurated in 1867 by the Rev. W. Branwhite Clarke (F.R.S., 1876). On his death in 1878 a medal in his honour was founded, which is awarded annually for researches in natural science, and struck in bronze. The obverse bears the bust of Clarke.

New Zealand Institute, Wellington.

Hutton Memorial Medal.—Founded in 1909 in honour of Capt. Frederick Wollaston Hutton, F.R.S., in association with a Hutton Research Fund. The medal is struck in bronze, and bestowed not oftener than once in every three years upon persons who have made "some noticeable contribution" in connexion with the zoology, botany, or geology of New Zealand. The awards are made only to those who have received the greater part of their education in New Zealand, or who have resided in New Zealand for not less than ten years.

Royal Society of Tasmania.

Johnston Memorial Medal.—In association with a lecture, this medal, struck in bronze, was established by public subscription to commemorate Mr. R. M. Johnston, a pioneer geologist (deceased 1918), author of "The Geology of Tasmania". Awarded at intervals, the first recipient (1923) was Sir T. Edgeworth David, F.R.S. The obverse bears the bust of Johnston.

Royal Anthropological Institute.

Huxley Memorial Medal.—Awarded annually in association with a memorial lecture given by some distinguished anthropologist, either British or foreign. The medal is struck in bronze; the obverse bears the bust of Thomas Henry Huxley.

Rivers Memorial Medal.—Founded in 1923, and awarded for specially meritorious field work in physical or cultural anthropology, preference being given to the claims of British subjects or fellows of the Institute. The medal is struck in bronze; the obverse bears the bust of Dr. W. H. R. Rivers, F.R.S.

British School of Archæology in Egypt.

Petrie Memorial Medal.—Founded in 1923, and awarded every five years for archæological work by English-speaking workers. The obverse bears the bust of Sir Flinders Petrie, F.R.S., long concerned in exploration and research in Egyptian archæology. The medal is struck in bronze.

Society of Apothecaries of London.

Society's Gold Medal.—Instituted in 1925, and awarded, usually annually, for services rendered to the science of therapeutics. The obverse bears the effigy of Galen, by T. H. Paget, after William Wyon, R.A.

Royal Botanical Society of London.

Society's Gold Medal.—Founded in 1840, and awarded for excellence in applied botany or flori-

culture. The Society was incorporated in 1839 for the promotion of botany and its application to manufactures, medicine, and the arts. Silver and bronze medals are also bestowed.

Institute of Brewing.

Horace Brown Gold Medal.—Founded in 1925 and awarded triennially for eminent services on the scientific or technical side of the fermentation industries, there being no disqualification in respect of nationality or sex in bestowal. The obverse of this memorial medal bears a replica of a crayon portrait of H. T. Brown, F.R.S., by Sargent.

Chadwick Trust.

Chadwick Gold Medal.—Founded under the testament of Sir Edwin Chadwick, K.C.B., in association with a prize, and awarded to such officer of the medical services of the Army, Navy, or Air Force as shall during the preceding five years have specially assisted in promoting the health of the men of the force to which he is attached through medical and sanitary work, or other scientific researches.

Royal Geographical Society.

Founder's Gold Medal.—At the foundation of the Society in 1830, its Royal Patron, King William IV., granted an annual premium of fifty guineas for the encouragement and promotion of geographical science and discovery. The fifth recipient received it in the form of a gold medal, and awards have been from that date, though not invariably, medallic. On the accession of Queen Victoria, the annual grant was continued, and it was resolved that for the future two gold medals should be awarded in each year: (*a*) the Founder's medal, to bear on the obverse the portrait of the founder; (*b*) the Patron's medal, to bear the portrait of the reigning sovereign. The two medals are equal in value and in honour.

Patron's Gold Medal.—(See above.)

Victoria Medal.—On the death of Queen Victoria in 1901, the council instituted the Victoria Medal, to be awarded from time to time for conspicuous merit in scientific research in geography. The medal bears on the obverse the portrait of the Queen (as in youth).

Royal Scottish Geographical Society.

Society's Gold Medal.—Instituted in 1890, and conferred by the council on distinguished geographers and travellers, irrespective of nationality, in consideration of special services to geographical science. Awarded at suitable periods, as also silver and bronze replicas in the same type.

Livingstone Gold Medal.—Instituted in 1901 by Mrs. A. L. Bruce in memory of her father, Dr. Livingstone. Awarded annually, irrespective of nationality, for distinguished service to geographical exploration or research. The obverse of the medal bears the bust of David Livingstone.

Bruce Medal.—See Royal Society of Edinburgh, Biological Sciences section.

Geological Society of London.

Wollaston Gold Medal.—First awarded in 1831, and established through the will (1828) of Dr. William Hyde Wollaston, F.R.S. The obverse bears the bust of Wollaston. The medal is bestowed annually.

Murchison Medal.—Founded in 1871, under the conditions of a geological fund established through the will of Sir Roderick I. Murchison, Bart., F.R.S. Awarded annually in bronze. The obverse bears the bust of Murchison.

Lyell Medal.—Founded in 1873 through the will (1875) of Sir Charles Lyell, Bart., F.R.S., and first awarded in 1876. The obverse of the medal, which is struck in bronze, bears the head of Lyell. It is bestowed annually without restriction of country or sex.

Bigsby Gold Medal.—Founded in 1876 by Dr. John J. Bigsby, F.R.S. Awarded biennially, without restriction of country. The obverse bears the bust of Bigsby.

Prestwich Gold Medal.—Founded in 1896 through the will of Sir Joseph Prestwich, F.R.S. Awarded triennially without restriction of country or sex. The obverse bears the bust of Prestwich.

Royal Horticultural Society.

The Society was founded in 1804; it aims at spreading a knowledge of the science of horticulture. Various medals applicable to different branches of the science are awarded. We select those associated with the early history of the Society, and of historic interest.

Banksian Medal.—Instituted in 1820 in commemoration of Sir Joseph Banks, F.R.S., one of the founders of the Society. Struck in bronze, silver, and silver-gilt; the obverse bears the head of Banks.

Knightian Medal.—Instituted in 1836 in commemoration of Thomas Andrew Knight, F.R.S., president 1811–38. Struck in bronze, silver, and silver-gilt; the obverse bears the head of Knight.

Lindley Medal.—Instituted in 1866 in commemoration of Dr. John Lindley, F.R.S., sometime secretary. Struck in bronze, silver, and silver-gilt; the obverse bears the head of Lindley.

Victoria Gold Medal of Honour.—Instituted in 1897 in commemoration of the sixtieth year of reign of Queen Victoria, and awarded to British horticulturists selected as deserving of special honour at the hands of the Society.

Linnean Society of London.

Linnean Gold Medal.—Founded in 1888, and awarded annually to a biologist of eminence, usually to a botanist and zoologist in alternate years. The obverse bears the bust of Linnæus.

Trail Medal.—Founded in 1910 in association with a fund established by Prof. J. W. H. Trail, F.R.S., "to encourage study that throws light upon the substance known as protoplasm, or the physical basis of life". The medal is struck in bronze and bestowed at intervals of not less than five years. The obverse bears the bust of Linnæus.

Crisp Medal.—Founded in 1912 and awarded in

association with a fund established by Sir Frank Crisp, Bart., in recognition of the best paper dealing with microscopical research by a fellow and published by the Society since the previous award. The medal is struck in bronze and bestowed at intervals of not less than five years. The obverse bears the bust of Linnæus.

Medical Society of London.

Fothergill Gold Medal.—Awarded triennially for significant advances in medical science. The Fothergillian medal was first awarded in 1787; in 1803 it was awarded to Edward Jenner. From 1893 the administration of the trust has been in conformity with a scheme of the Charity Commissioners. The most recent award (1929) was to Sir Thomas Lewis, F.R.S. The obverse of the medal bears the bust of Anthony Fothergill, M.D.

Royal Society of Medicine.

Society's Gold Medal.—Awarded triennially to a man of science (or a woman) who has made valuable contributions to the science and art of medicine. Established in 1920 through funds provided by the late Dr. R. Murray Leslie.

Jenner Memorial Medal.—Founded in 1896 by the Epidemiological Society (now merged in the above society) "in recognition of the greatest medical service ever done to man". Awarded, struck in bronze, for services in the prevention and control of epidemic disease. The obverse bears the bust of Jenner.

British Medical Association.

Association Gold Medal.—Founded in 1877 and bestowed annually "For Distinguished Merit". Awards are made to those who shall have conspicuously raised the character of the medical profession by scientific work, by extraordinary professional services, or by special services rendered to the Association.

British Medical Association, Australia Branch.

Association Gold Medal.—The Federal Committee in Australia instituted a medal in 1924 for distinguished service, and for the purpose of "perpetuating the appreciation of the Federal Committee of signal services rendered by members of the British Medical Association in Australia".

British Medical Association, South Africa Branch.

The institution of a medal has been decided on; regulations for award are under consideration.

Liverpool School of Tropical Medicine.

Mary Kingsley Medal.—Commemorates the work of Mary Kingsley in West Africa, and bestowed in recognition of distinguished scientific achievement. There is no restriction as to nationality in the award. The medal is struck in bronze, and the obverse bears the bust of Miss Kingsley.

Pharmaceutical Society of Great Britain.

Hanbury Memorial Gold Medal.—Founded in 1875, and awarded biennially for "high excellence in the prosecution or promotion of original research in the chemistry and natural history of drugs". The medal commemorates Daniel Bell Hanbury, remembered for his researches in materia medica; the obverse bears his head.

Harrison Lectureship Medal.—Founded in 1921, and associated with a biennial lecture on a subject relating to the science and practice of pharmacy. The medal, struck in silver, commemorates Lieut.-Col. E. F. Harrison, deputy controller of the Chemical Warfare Department during the War. The obverse bears the head of Harrison.

The Society also bestows annually the silver Pereira Medal, as the result of examination, to a pharmaceutical chemist. The medal (founded in 1860) commemorates Jonathan Pereira, the classic teacher of materia medica.

Royal College of Physicians, London.

Baly Gold Medal.—Founded in 1866, arising from a trust fund established by Dr. F. D. Dyster, "in memoriam Gulielmi Baly, M.D.". Awarded biennially to the person who shall be deemed to have most distinguished himself in the science of physiology, especially during the two years immediately preceding, and is not restricted to British subjects. The obverse bears the bust of Baly.

Moxon Gold Medal.—Founded in 1886 through a trust fund established as a memorial of Dr. Walter Moxon. Awarded triennially to the person who is deemed to have most distinguished himself by observation and research in clinical medicine. Bestowal is not restricted to British subjects. The obverse bears the bust of Moxon.

Weber-Parkes Medal and Prize.—Provision is made under the terms of a trust established in 1895 by Dr. (afterwards Sir) Hermann Weber in memory of Dr. E. A. Parkes, for a prize of one hundred and fifty guineas, accompanied by a silver medal. The subject scheme of the prize relates to tuberculosis. The allotment is triennial, and is not restricted in nationality. The obverse bears the bust of Weber.

Bisset Hawkins Gold Medal.—Instituted in 1896 as a memorial to Dr. Francis Bisset Hawkins, and bestowed triennially on some duly qualified medical practitioner, who is a British subject, and has, during the preceding ten years, specially advanced sanitary science or promoted public health. The obverse bears the bust of Bisset Hawkins.

Royal Sanitary Institute.

Rogers Field Medal.—Founded in 1901, and awarded in silver for the first time in 1903. It commemorates the work of Mr. Rogers Field, a pioneer of sanitation, and is bestowed in connexion with the annual congress of the Institute for an exhibit of special merit from a hygienic point of view. The obverse bears the head of Field.

Royal College of Surgeons of England.

Honorary (Gold) Medal.—Instituted in 1802, and bestowed at varying intervals. In awarding, the leading considerations are liberal acts or distinguished labours, researches, and discoveries,

eminently conducive to the improvement of natural knowledge and of the healing art.

John Hunter Medal and *Triennial Prize.*—The medal itself, executed in bronze, was founded in 1867, and is allocated with the (older) triennial prize. From 1925 the terms of this joint gift provide for award to some fellow or member of the College who has, during the preceding ten years, done such work in anatomy, physiology, histology, embryology, or pathological anatomy, as deserves special recognition. The obverse bears the bust of Hunter.

Lister Medal.—In 1920 the College became trustees of the Lister Memorial Fund, and the following provision is in operation: That out of the General Fund a sum of £500, together with a bronze medal, be awarded every three years, irrespective of nationality, in recognition of distinguished contributions to surgical science, the recipient being required to give a lecture in London under the auspices of the College. The obverse of the medal bears the head of Lord Lister.

Cartwright Medal.—Awarded quinquennially in bronze, with an honorarium, to the author of the best essay upon a subject relating to dental surgery, and selected by the council upon the recommendation of a committee. The medal was bestowed for the first time in 1911, and bears on the obverse the head of Samuel Cartwright, F.R.C.S.

Royal College of Surgeons of Edinburgh.

Caird Medal.—Founded in 1927, in association with a money gift, as a memorial to Francis Mitchell Caird, Regius professor of clinical surgery, University of Edinburgh, 1908–1919. It is to be awarded triennially in bronze for an essay on a subject in surgery or surgical pathology, based on personal observation and research, and open to graduates of Edinburgh and to licentiates and fellows of the Royal College of Surgeons who have studied in Edinburgh for a period of at least two years, and have been qualified as practitioners for not more than seven years. The precise design of the medal has not yet been settled, but an award under the scheme will be made shortly.

Royal College of Veterinary Surgeons.

Steel Memorial Medal.—Instituted in 1891 in memory of John Henry Steel, Army Veterinary Department, principal of the Bombay Veterinary College, and awarded by the council triennially as a reward for scientific or literary work of merit connected with the veterinary profession. The medal is struck in silver, and fellows and members of the College are alone eligible. The obverse bears the head of Steel.

Zoological Society of London.

Society's Medal.—In 1837 the council decided to "offer six medals annually, by way of premiums, for subjects connected with zoology". In 1847 two medals (the first), struck in silver, were awarded, in 1859 nine. "Silver medals have continued to be awarded at irregular intervals, and for very different reasons, and it may be an important duty of the Council at some future time to revert more to the original intention of the Society and present medals annually for specific contributions to zoology, in the form of the introduction of very rare animals, or for direct contribution to knowledge" ("Centenary History of the Zoological Society of London", 1929). The Society's medal struck in bronze has usually been given to keepers for special services.

Royal Zoological Society of Ireland.

Animal Photography Medals.—The council allots a silver and bronze medal respectively for sets of photographs taken in its gardens by amateurs.

Royal Geological Society of Cornwall.

Bolitho Gold Medal.—Instituted under the will (1895) of Mr. William Bolitho, and awarded annually for such member whose attainments, labour, and discoveries in geology or mineralogy shall best deserve recognition. This, the senior scientific society of Cornwall, was founded in 1814. The first bestowal of the medal (1896) was made to Prof. R. Etheridge, F.R.S.

Royal Institution of Cornwall.

Henwood Gold Medal.—Awarded triennially for the best treatise or paper in the subjects of geology, mineralogy, mining operations, botany, ornithology, ichthyology, conchology, or antiquities of Cornwall. The gift arises under the will of William Jory Henwood, F.R.S., who died in 1875. Bestowal is not confined to members. The obverse bears the head of Henwood.

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Obituary.

DR. W. M. W. HAFFKINE.

THE death of Waldemar Haffkine on Oct. 26 last will recall an era in bacteriology of which few of the active participators still survive.

The discovery in 1880 by Pasteur, that fowl cholera can be prevented by the inoculation of living attenuated cultures, and his success with this disease, as also with swine erysipelas, anthrax, and hydrophobia, seemed to open up a field of endless possibilities. One of the early workers to transfer this activity to human beings was Haffkine, who was enabled to go to India and inoculate vast numbers of people against Asiatic cholera and bubonic plague. Following the Pasteurian tradition, he first used living cultures, as Ferran y Clua (1852–1929) had done before him in Spain. The results were not satisfactory; and later, Haffkine turned to the use of killed cultures, the value of which had previously been shown (1884–1886) by D. E. Salmon and Theobald Smith in America in the case of prophylactic inoculation against hog cholera.

Waldemar Mordecai Wolff Haffkine was born in Odessa on Mar. 16 (3), 1860, the son of Aaron Haffkine. He received a classical education at Berdiansk (South Russia) and studied science in the University of Odessa (1879–83). He afterwards worked at the Zoological Museum in Odessa (1883–88) and then came west as assistant professor of physiology in the Medical School of Geneva. Ultimately, he made his way to Paris in the wake of Metchnikoff, met Pasteur, and was appointed (1889) *préparateur* at the Pasteur Institute, which had been inaugurated the previous year. He remained in this post until 1893, when he went to India full of ideas of stamping out cholera by prophylactic inoculation. Here he found a great field for his efforts and in the midst of his work he turned aside to combat another scourge—bubonic plague—which was beginning to get a firm hold of Bombay. Under his directions vast quantities of the protective vaccines were made and inoculated on a wholesale scale. In the course of his labours he received great publicity and fame, partly on account of the enthusiasm of his personality and partly on account of the uncritical attitude towards some of his results.

Haffkine was regarded as a kind of second Jenner, but when a study of his plague results was made by the English Plague Commission in India, the report was, on the whole, adverse to his claims. None the less, he was regarded as a bacteriological wizard. He retired from the India service in 1915 and returned to Europe, where he lived for a time in Paris and afterwards at Boulogne-sur-Seine. He wrote relatively little of a scientific character in bacteriology. W. B.

WE regret to announce the following deaths:

Dr. J. V. Elsden, joint editor of the *Colliery Guardian* and author or part author of several well-known geological works, and treasurer from 1916 until 1921 of the Geological Society of London, aged seventy-four years.

Mr. C. J. B. Macdonald, an honorary life governor of the Royal Agricultural Society of England and editor since 1927 of the Society's *Journal*, on Nov. 10, aged sixty-six years.

Prof. E. R. Matthews, chief drainage engineer to H.M. Office of Works, and formerly Chadwick professor of municipal engineering in the University of London, on Nov. 6, aged fifty-seven years.

News and Views.

HIS Majesty the King has approved of the following awards this year by the president and council of the Royal Society in respect of the two Royal Medals: Royal Medal to Prof. O. W. Richardson, for his work on thermionics and spectroscopy; Royal Medal to Prof. J. E. Marr, for his pioneer work in the accurate zoning of the palæozoic rocks. The following awards of medals have also been made by the president and council: Copley Medal to Sir William Bragg, for his distinguished contributions to crystallography and radioactivity; Rumford Medal to Prof. Peter Debye, of Leipzig, for his work relating to specific heats and X-ray spectroscopy; Davy Medal to Prof. R. Robinson, for his work on the constitution and synthesis of natural products, and for his contributions to the theory of organic reactions; Darwin Medal to Prof. Johannes Schmidt, of Copenhagen, for his work on extended oceanographical expeditions, and for his genetic studies in animals and plants; Hughes Medal to Sir Venkata Raman, of Calcutta, for his studies on the abnormal scattering of light.

THE following is a list of those recommended by the president and council for election to the council of the Royal Society at the anniversary meeting on Dec. 1: *President*: Sir F. Gowland Hopkins; *Treasurer*: Sir Henry Lyons; *Secretaries*: Dr. H. H. Dale and Dr. F. E. Smith; *Foreign Secretary*: Lord Rayleigh; *Other Members of Council*: Prof. E. V. Appleton, Prof. G. Barger, Prof. A. E. Boycott, Prof. E. P. Cathcart, Sir Alfred Ewing, Prof. E. S. Goodrich, Prof. G. H. Hardy, Sir Harold Hartley, Sir Thomas Lewis, Dr. W. H. Mills, Prof. E. A. Milne, Dr. A. B. Rendle, Prof. R. V. Southwell, Prof. G. I. Taylor, Prof. D. M. S. Watson, and Prof. W. W. Watts.

SIR ARTHUR KEITH was elected Rector of the University of Aberdeen on Nov. 8 in succession to the late Lord Birkenhead. Sir Arthur, who was a non-political candidate, was opposed by Col. John Buchan, M.P. (Unionist), and obtained a majority of votes in each of the 'nations', Mar, Buchan, Angus, and Moray, the total numbers being 310 as against 231. Although not unprecedented, the election of a non-political candidate is rare. Sir Arthur was formerly a student of Aberdeen and as one of the most distinguished of its *alumni* now living had a strong claim on the suffrages of the members of his University. His studies in the comparative morphology of the Simiidæ—in particular of the anthropoids—and

of early types of man have served to support as well as to elucidate the Darwinian hypothesis of the descent of man. His gift of lucid and graceful exposition has won him an unrivalled place as a public lecturer, as is testified by the fact that he has held all the lectureships open to members of the medical profession. By his more popular writings and lectures he has done much to stimulate the interest of the general public in the problems of anthropological science. In his official capacity as Curator and then Director of the Royal College of Surgeons, he has indeed deserved well of the members of the medical profession. Among the many positions of honour to which he has been called, it will suffice to mention the presidential chair of the Anatomical Society, of the Royal Anthropological Institute, and of the British Association at its Leeds meeting in 1927. We offer Sir Arthur our congratulations on this latest and perhaps most welcome of his honours.

THE pamphlet "How to Tackle Unemployment", published last week by the Liberal party, contains no strikingly new ideas. The policy advocated by its authors, Mr. Lloyd George, Lord Lothian, and Mr. Seebohm Rowntree, differs little from that outlined in "Labour and the Nation", which has been the inspiration of the Labour party for the past three years. Neither the analysis of the causes of the present world-depression and the decline of British basic industries, nor the suggested remedies for unemployment, bears the stamp of originality. It is indeed unlikely that the Labour Government's Economic Advisory Council, among the members of which are Sir Daniel Hall, Mr. J. M. Keynes, and Mr. G. D. H. Cole, had not already reached much the same conclusions as to causes and submitted similar remedial schemes in even more detail than those put forward in the pamphlet. Nevertheless, the task of industrial reconstruction will undoubtedly be made easier by the publication of the Liberal leaders' selective synthesis, not the least noteworthy part of which is the recognition given to the part which scientific and technical knowledge should play in the future development of the British Empire.

THE Liberal pamphlet contrasts the position of the scientific and technical experts in Germany with their position in Great Britain. In Germany the Credit Banks are equipped with expert staffs "capable of investigating both the efficiency of going concerns and the soundness of proposed industrial ventures", and in consequence even small concerns have often been enabled to raise necessary capital from the public. In Great Britain the "bankers are masters but have so far not felt it proper to accept responsibility for enforcing reorganisation or greater efficiency" in industry, largely due to the fact that they have not appropriate experts on their staffs or scientific or technical experts on their boards of directors. The pamphlet also deals with the important part which science has to play in the development of those parts of the world where the standard of living is very low, and particularly of the British Colonial Empire. The proper investment of capital would enable agriculture, the basic industry of our colonies, to be developed scientifically and inevitably raise the standards of life of the backward races; this, over a period of time, would play an extremely important part in the solution of the unemployment problem. Both at home and overseas "enterprise . . . will increasingly take the form of the exploitation of new scientific development and new inventions". It is not suggested that it is the business of governments to be responsible for invention, but it is asserted that governments should assist in every way to create the conditions whereby the pursuit of industrial research and the discovering and wise application of invention are encouraged to the utmost.

IN a pamphlet entitled "The Agricultural Crisis and the Way Out" (Messrs. Jarrold and Sons, Ltd., Norwich, 3*d*.), Dr. Cloudesley Brereton points out that agriculture is still the basic industry of Great Britain and still employs the largest number of hands, though a million acres have gone out of cultivation and 100,000 agriculturists have left the land. Since 1922, the great majority of farmers have been losing money year by year and there has been a progressive drop in the prices of wheat, barley, and oats. Prices, indeed, for most kinds of agricultural products are unnaturally low, according to Dr. Brereton, partly because farmers have not organised their marketing and partly because of the unrestricted competition of foreign produce. Traders in meat, bread, and vegetables have become highly organised as a result of the impetus given by War-time organisation for the distribution of food, and they have been able to force a lower price on the producer and to raise prices against the consumer. They have ceased to interest themselves in helping the farmer to get rid of any surplus during a glut, preferring to buy a more or less fixed amount, regardless of the supply available, and to retail it at more or less fixed prices according to the season. Dr. Brereton looks for a solution of the agricultural problem in the development of some form of organised marketing, though he holds that until this is developed nothing but a guaranteed price for wheat, with a duty on foreign malting barley and the prevention of 'dumping', can tide the farmer over the interval. The cost to the Government would gradually decrease as marketing schemes were developed. The German plan of compelling all millers to grind a fixed quota of home-grown wheat might also be adopted.

A USEFUL pamphlet by P. Good describing the organisation of the electrical industry in Great Britain has just been published by the Institution of Electrical Engineers. About sixty organisations are described, beginning with the Institution of Electrical Engineers and finishing with the British National Committee of the World Power Conference. The Electrical Research Association (E.R.A.) co-operates with those responsible for the laboratories in the universities, technical colleges, and schools throughout the country. This forms a valuable link between the colleges and industry. The value of the work done by this Association is known to be far in

excess of the expenditure incurred. The research carried out on overhead transmission lines at a comparatively trifling cost has been shown to represent a saving of 10 per cent on the three million pounds per annum expended on constructing these lines. The Electricity Commissioners Department also, which has been entrusted with supervising the supply of electricity throughout Great Britain, has done an immense amount of work. The country has been divided into eight areas, and very complete statistics regarding the number and nature of the undertakings in these districts have been collected. The Commissioners have paved the way for the centralisation of the supply, which is at present proceeding rapidly. The Institute of Transport is linked up with the electrical industry owing to the many important developments in the application of industry to transport which have recently taken place. It is a little disappointing to read that the total route mileage electrified in England is only 615·8, of which 307·7 miles, or nearly half, has been done by the Southern Railway.

"HEREDITY and Predestination" was the subject of the Lloyd Roberts Lecture delivered by Dr. Barnes, the Bishop of Birmingham, at Manchester Royal Infirmary on Nov. 7. It is an effort to mould upon some of the biological theories of the day an interpretation of the relationship of man to God, or, perhaps more accurately, it may be said to be an attempt to support certain widely held beliefs by particular appeal to the notion of genes as the repositories of unit characters. The general progress of the inorganic and organic worlds, culminating in civilised man, leads Dr. Barnes to a belief in the purpose and intelligent will of God. He does not believe in the inheritance of acquired characters, nor will he risk being called a vitalist, but he is a thorough-going believer in the gene. "Tennyson's words, 'Man is man and master of his fate', must be altered to 'The genes are genes and masters of man's fate'." Now changes in the genes appear to be the raw material of evolution, and through them the creative process works; that is to say, if ethical theism be accepted, that in modifications of the genes the activity of God is expressed. Yet modifications of the genes, expressed in visible mutations, seem to be devoid of any ethical character whatever, so that, as Dr. Barnes sees the matter, good and evil arise with equal frequency in the variations associated with heredity, but the Divinely guided creative process of which we are products is active through the environment. The determinism which is implied in inheritance does not necessarily mean that we have no freedom of choice.

DR. BARNES goes on to say that "the notion that evil is due to a fall, to some act of spiritual rebellion against God, must be abandoned", since we have learned that evil and good are equally likely to arise at every stage of the evolutionary process. The 'evil and good' of his argument are simply adjustment or maladjustment to environment: the good are the survivors, the evil the individuals smothered by circumstances. Man has so modified circumstances that now ill-adjusted individuals of humanity are constrained to survive, and this survival of 'evil' is one of the great problems of social progress. We are entirely with Dr. Barnes in his plea for further research into the inheritance of feeble-mindedness, but we cannot see that his appeal to the gene has furthered the problems with which he deals. If genes are realities, it is impossible to say that they are the ultimate sources of variation; it is equally difficult to believe that the action of environment is less deterministic than the variation of the ultimate units of life; but—and this lies at the foundation of the argument—there is no certainty in the statement that mutations are equally good and evil, or in the notion that they are causeless in the sense of being entirely fortuitous.

"SCIENCE and Modern Industry" was the subject taken by Sir William Pope for his Norman Lockyer lecture to the British Science Guild on Nov. 13. Modern man, he said in the course of the lecture, is to no appreciable degree the intellectual superior of his predecessor who lived in the far fringe of historic time. The invention of expressive and flexible languages, the existence of great literatures, the execution of gems of art, and the development of moral philosophy thousands of years ago, when compared with man's powers to-day, suggest that some forms of intellectual expression have long since been worked out to the utmost limit of the capacity of the human intelligence. In the study of the natural sciences, on the other hand, there finds expression a new faculty; the application of deductive reasoning to experimental observations carried out in accordance with a connected scheme and leading to an understanding of the ways of inanimate Nature is a new phase in man's intellectual history. The scientific age has provided us with a liberal supply of creature comforts, with more freedom from toil and more leisure than could have been dreamt of a century ago; moreover, it has seen the foundation of great industries. Modern industry, consisting in the application of science to industry, can serve national or international needs with economy and efficiency only when legislative or other control is exerted scientifically. Sir William Pope developed his argument by reference to the rise, decline, re-birth, and protected development of the coal-tar dyestuff industry in Great Britain, explaining the principal factors controlling the situation and the form of legislative assistance which has been accorded to the industry during the past ten years. The building up of a virile dyestuff industry in Great Britain has necessarily been accompanied by advantage to every branch of chemical industry and science, so that uncertainty whether the Government proposes or not to renew the relevant Act causes widespread embarrassment.

So much information concerning the manufacture and consumption of dyestuffs in Great Britain is available as to afford the practical certainty that the issue of national interest could be decided on questions of fact by a judicial body. "Scientifically-minded people," said Sir William Pope, "whether academic or industrial, have no convictions; they frame their conclusions and actions on the facts." Some of the great

industries of Great Britain, particularly the agricultural industry, are archaic in their methods and outlook; it is significant that in Germany agriculture is by far the largest domestic consumer of chemical products, whilst in England far too little advantage is being taken of artificial manures. Turning to the consideration of preparation for an industrial career, Sir William insisted on the profound distinction between education and instruction. The attainment of a mastery over general principles is a slow process, because it involves education, and the learning of experimental methods calls for long and laborious laboratory training, whilst theoretical organic chemistry, for example, offers an easy task to the youthful trained memory. It is common to find that the young man's handwriting and spelling are execrable, his knowledge of leading facts and ideas imperfect, and his knowledge of foreign languages quite inadequate, while he is stuffed with facts relating to highly specialised branches of science. Sir William Pope did not advocate a return to the classical and mathematical education of former days, but he asked that the schools should provide an education in the broad principles of the natural sciences and methods, supplemented by liberal and simple courses of practical work in the laboratory. Business men who had received a broad scientific education would find themselves capable of assessing at their true value many of the fantastic proposals which are continually being laid before financiers.

THE discovery of an unusual type of implement in the Swanscombe gravel pit at Northfleet, Kent, is announced in the *Times* of Nov. 6. Its interest lies in the fact that this type is unlike anything previously known in England or on the Continent, with the exception of certain implements found at Clacton-on-Sea by Mr. Hazzledine Warren, and others somewhat similar, also found by Mr. Warren, at Stoke Newington. The Abbé Breuil has therefore suggested the name 'Clactonian' for the new industry. The discovery was made by Mr. R. H. Chandler in the bottom gravels of the pit ten feet below the middle gravels in which St. Acheul hand-axes were found in excavations in 1913, of which characteristic examples are now in the British Museum. In these previous excavations some flakes only were found in the bottom gravels. The predominant tool in the present discovery is a species of chopper, of which the cutting edge has been produced by flaking a flint nodule with alternate strokes from right and left. Some of the flints are striated. The tools are associated with a warm fauna, the straight-tusked elephant, rhinoceros, and deer. Hence it is suggested that the striated tools may have been made before the Mindel glaciation, while those without striation and associated with the warm fauna may have belonged to the Mindel-Riss interglaciation. They would thus come between Chellean and Acheulean and might be classified as Early Acheulean.

THE October issue of *Man* is a special number devoted to India, embodying some of the results of the work of the Indian Research Committee of the Royal Anthropological Institute. For some time a special committee has been engaged in the investigation of Indian beads. It was with the assistance of this committee that Miss Caton-Thompson was enabled to arrive at a dating for the Rhodesian ruins at Zimbabwe. The number opens with a brief account of the work of the committee by Prof. J. L. Myres, president of the Royal Anthropological Institute, which is followed by a contribution by Mr. H. C. Beck, "Notes on Sundry Asiatic Beads," illustrated by two plates, of which one is a beautiful reproduction in colours of some of the more striking and important types. Mr Beck deals with beads from burial sites—megalithic, cairn, and urn burials—in India, the Malay Peninsula, and Sarawak. Some of the beads are of considerable antiquity, and Mr. Beck by comparative study traces them to their probable origin. Some of the beads show affinities with Crete, while others are of Roman origin. A series of articles by Mr. L. A. Cammiade describes the excavation of urn burial sites in Southern India, and particularly the Madras Presidency, from which some of the beads described by Mr. Beck were derived. The area of these urn burial sites was sometimes considerable, running to as much as a quarter of an acre. The urns were of various types, and inside the large urns were smaller urns, in one case as many as twenty-two in number. There were no signs of cremation.

THE custom of urn burial revealed by the excavations described by Mr. Cammiade is extremely interesting. In certain cases it is highly artificial, as Mr. Cammiade points out. While some of the large urns contained a body entire, in others—those in which the smaller urns were contained—the small bones, the phalanges and carpals, had been placed in small urns, the skull and some of the other bones were found among the contents of the urn, and the long bones were leaning against the internal sides of the urn. The culture of the cairn and urn burials of Southern India is discussed by Mr. K. de B. Codrington. He is of the opinion that they belong to a single culture complex in Southern India, presenting affinities with Northern India which it is not yet possible to work out. The date approaches somewhere about the borders of the historic period; it may be about 600 A.D. The burial customs appear to link up with modern practice; but the interesting feature is that they appear to be the final stage of the burial rite and to be communal, the bodies having been reserved until the time of interment came. The rich were interred entire; but of the poor, some of the bones only were interred symbolically.

DURING the naval review off Portland on Nov. 1, three battleships, the *Warspite*, *Barham*, and *Malaya*, were engaged from 3 P.M. to 3.20 P.M. in concentration firing from 15-inch guns. According to the *Times* correspondent on board the *Nelson*, which was little more than a mile from the firing ships, the reports did not seem unduly loud. They were heard, however, according to letters in recent issues of that paper, at considerable distances from Portland, the farthest place being Towcester in Northamptonshire (130

miles) and the nearest Littlehampton in Sussex (83 miles)—not unusual distances when a silent zone is developed. When plotted on a map, the 25 places are seen to lie within an oval area 113 miles long from north-west to south-east and 56 miles wide, the centre of the area being about one hundred miles north-east of Portland.

THE British Photographic Research Association has gone into voluntary liquidation; this decision has been reached in full accord between the Department of Scientific and Industrial Research and the manufacturer members of the Association. Two main factors have necessitated this decision. The first is that important changes have taken place in the organisation of the industry itself; manufacturing interests have been consolidated and as a result the number of separate firms interested in the work of the Association has been considerably reduced. The second factor is a very marked increase in the research work carried out in the laboratories of the manufacturing firms themselves—an increase which has, to a large extent, been the outcome of the work of the Association. This widening of the outlook of the industry with regard to research is one of the results which it was hoped the Association would achieve, and the development has been much fostered by the policy of the Director of the Association, Dr. T. Slater Price, in keeping the scientific staffs of the manufacturing firms in close touch with the research work carried out in the laboratories of the Association, and also with the latest scientific developments likely to have direct application to problems of the industry.

DR. PHILIP EGGLETON delivered an address before the Royal Society of Edinburgh on Nov. 3, on recent work in the biochemistry of muscle. In studying the muscular engine, two chemical systems—which may prove to be quite distinct—have to be sought. One is responsible for the energy of contraction, an anærobic set of processes, and the other is concerned with the 'recharging' phase, oxidative recovery. The view that the formation of lactic acid from carbohydrate is the core of the former system, and its partial oxidation is the essence of the latter, has had to be seriously modified as a result of several recently reported facts, notably the discovery by Lundsgaard that in certain circumstances work may be done anaerobically by a muscle without the formation of any lactic acid. The newer additions to our knowledge do not weaken the hypothesis that the oxidation of lactic acid provides the energy for recuperation, but they necessitate a fresh search for the chemical contractile mechanism. It has been suggested by Meyerhof that the breakdown of phosphagen (which Lundsgaard observed even in the muscles incapable of lactic acid production) is a reaction capable of supplying the necessary energy for this phase. There are difficulties in the way of this suggestion, but the only alternative at present is to place the responsibility on some reaction, or set of reactions, as yet undiscovered.

THE presidential address of Sir George Humphreys to the members of the Institution of Civil Engineers on Nov. 4 was appropriately devoted to a review of the activities of the London County Council during the period of twenty-eight years in which Sir George has been associated with that body, for the later portion as its Chief Engineer and Administrator of Housing. The population of Greater London has increased from 6,600,000 in 1901 to nearly 8,000,000 at the present day, and the problems presented by its growth and redistribution have been of an extremely interesting character. Sir George reviewed the various spheres of administration and development, including the drainage area of 180 square miles, with its main outfalls at Barking and Crossness, pointing out that within the area surrounding the County (117 square miles) to a radial distance of 25 miles from Charing Cross, there are so many as two hundred separate sewage works, the effluents from which find their way into the Thames. The problem of making comprehensive provision for these and additional areas within the catchment basin is now engaging the attention of the Ministry of Health. As regards water supply, the greater part of the water for the 574 square miles served by the Metropolitan Water Board is drawn from the Thames and the remainder from the Lee and from wells. The Board has to-day available storage reservoirs for 19,657 million gallons, and despite some restriction of use in 1929, it has maintained a supply of about 100,000 million gallons of water per annum for a population of about 7¼ millions. The Thames bridges, tunnels, and river protection works were alluded to, and the various public services, including transport, briefly surveyed. The address concluded with a reference to housing accommodation for the working classes, and stated that the contributions of the London County Council and the borough councils, since the War, had amounted to about 40,000 and 11,000 dwellings respectively, the former constituting, in a number of cases, small townships, such as the Becontree estate at Dagenham with 25,000 houses and the St. Helier estate near Morden with 10,000.

IN the recent presidential address to the Society for Psychical Research, delivered by Dr. Walter Prince, of Boston, U.S.A., which is printed in the Society's *Proceedings* for October, the speaker laid stress upon the unsatisfactory methods generally employed for the investigation of the so-called physical phenomena of spiritualism, and outlined a number of conditions which it would be desirable to demand. He compared the nature of the evidence as regards these alleged physical phenomena with that of certain of the mental phenomena, such as scrying and clairvoyance. With respect to these, he maintained that so far from explaining away the phenomena, psychical researchers have brought some of them far on the way to factual establishment. Dr. Prince considers that telepathy is proved, and attempts to dispose of many of the mental phenomena have been met with swift rebuttal. Continuing, Dr. Prince referred to a few cases which seem difficult to explain normally, and in conclusion stated that what is needed is more observation until finally the meaning and significance of the phenomena will become clear.

FROM *Věstník*, the publication of the Museum of Czechoslovakia, we learn that at an auspicious inauguration ceremony on May 4, an Agrarian Museum in Bratislava was thrown open to the people. The building of the museum has taken four years, and now ten rooms are devoted to general exhibits and four to a historical section. The aim of the museum is to inculcate in the peasantry a new interest in their own country, in the development of its agriculture, and in the struggles of their ancestors; and through these to promote further progress in agriculture. The care with which the museum has been planned, both as regards the buildings and the collections which they are to house, speaks well for the foresight of its organisers, and it is not surprising to learn that the Slovak peasants welcome the new cultural institution, which gives a feeling of unity and solidity to their industry. The opening of the museum was celebrated as a holiday by the Slovak peasantry and the whole agricultural population in Czechoslovakia.

"IN these times when our traditional human pairings are being so widely criticised and so boldly relaxed, there is a biological warning—Beware of Reversions." In the course of an article in the *Quarterly Review* for October, Sir J. Arthur Thomson recalls, in the light of recent researches, the trend of the evolution of sex in the animal kingdom. His excellent summary of the many-sided progression of sex structures and sex behaviour leads to conclusions which bear upon human affairs, for he is convinced that man, when willing to use science as his torch, has much to gain from a survey of the sub-human world of life. A wide survey of the evolution of sex throughout the animal kingdom shows the gradual enhancement of sex attraction by the addition of the psychological to the physiological, and by the addition of finer sympathies and synergies to the sensory attraction. Where a prolonged courtship is subtle, as Julian Huxley has shown it to be with the great crested grebe, it forges psychical bonds which last and keep the two birds loyal partners long after the sex-fondness has passed into abeyance. The main lesson of the evolution of sex, Sir Arthur concludes, is that fondness should rise into love, and that the earth-covered roots should feed a stem that bears the flowers of the spirit and the seeds of an evolving race.

AT the ordinary meeting of the Institution of Electrical Engineers to be held at 6 P.M. on Thursday, Nov. 20, an oil painting of Ampère will be presented to the Institution on behalf of Mr. E. Garcke. The portrait is by Mr. Edgard Maxence, Member of the Institute of France.

IT is announced in *Science* that the Abbé Henri Breuil, of the Institut de Paléontologie Humaine, Paris; Sir Arthur Keith, of the Royal College of Surgeons, London, and Prof. G. Elliot Smith, of University College, London, have been elected corresponding members of the Field Museum of Natural History, in recognition of services rendered to the museum.

SCIENCE Service announces that Admiral Watson Taylor, U.S.N., retired, has been awarded the John Fritz Medal for his outstanding achievement in marine architecture, particularly in relation to hull design, as Chief Constructor of the United States Navy during the War. The award is made by the four American societies of civil, mining and metallurgical, mechanical, and electrical engineers.

THE third Liversidge lecture of the Chemical Society, which was to have been delivered by Prof. H. B. Dixon, will be given at 5.30 P.M. on Dec. 11 by Prof. W. A. Bone, at the Imperial College of Science and Technology, South Kensington. Prof. Bone will take as his subject, "Fifty Years' Experimental Research upon the Influence of Steam on the Combustion of Carbonic Oxide (1880–1930)".

THE annual meeting of the Institution of Naval Architects will open on Wednesday, Mar. 25. At the invitation of the Association Technique Maritime et Aeronautique, the summer meeting will be held in Paris early in July 1931. The International Exhibition at Vincennes (near Paris) will add to the interest of the meeting, and it is proposed to visit one of the shipbuilding centres in France.

THE following officers for the session 1930–31 of the Philosophical Society, University of Durham, have been elected: *President*: The Hon. Sir Charles A. Parsons; *Hon. Secretary*: Mr. W. M. Madgin, Armstrong College, Newcastle-upon-Tyne; *Hon. Treasurer*: Mr. J. W. Bullerwell, Armstrong College, Newcastle-upon-Tyne; *Editor of Proceedings*: Prof. G. W. Todd; *Librarian*: Dr. F. Bradshaw.

AT a meeting of the Geological Society of London on Nov. 5, Prof. P. Lemoine, Paris, and Prof. G. A. F. Molengraaff, Delft, were elected foreign members of the Society; and Prof. R. S. Bassler, Washington (D.C.); Prof. O. Mügge, Göttingen; Dr. D. I. Mushketov, Leningrad; Madame M. Pavlov, Moscow; Prof. P. D. Quensel, Stockholm; and Prof. E. Stensiö, Stockholm, were elected foreign correspondents of the Society.

THE following appointments have recently been made by the Secretary of State for the Colonies: Mr. W. G. Higgins, to be agricultural field officer, Federated Malay States. Mr. C. M. Maggs, to be horticultural assistant, Federated Malay States. Mr. V. Liversage, to be agricultural economist, Kenya. Mr. F. B. Notley, to be assistant entomologist, Kenya. Mr. G. M. Roddan, to be provincial superintendent of agriculture, Sierra Leone. Mr. E. Harrison, deputy director of agriculture, Kenya, to be director of agriculture, Tanganyika Territory. Mr. G. W. Lock, to be district agricultural officer, Tanganyika Territory. Mr. R. P. Davidson and Mr. A. J. Kerr, to be agricultural officers, Uganda. Mr. G. Griffith, to be assistant agricultural chemist, Uganda. Mr. W. Small, mycologist, Ceylon, to be director of agriculture, Nyasaland. Mr. E. P. Hodgkin, to be entomologist (Medical Service), Kenya. Mr. M. E. Dommen, to be assistant conservator of forests, Cyprus.

IN the column of "Historic Natural Events" in NATURE of Nov. 8, p. 744, it is stated that Tycho Brahe discovered Nova Cassiopeiæ on Nov. 11, 1572, from Uraniborg. The observation was made, however, at the castle of Herritzvad, near Knudstrup, where Tycho Brahe's maternal uncle, Steno Belle, had permitted him to instal a laboratory. The first stone of the observatory of Uraniborg was laid on Aug. 8, 1576.

THE *Guide to Current Official Statistics* is a very useful annual publication of H.M. Stationery Office (price 1*s*.). The volume for 1929 has now been issued. There are two main divisions of the guide. The larger part is occupied by a detailed subject index which gives the numbers of the relevant publications. In the second part these are serially listed with titles and contents. This arrangement makes it easy to discover if there is an official publication on any subject.

THE annual report for the year ended Mar. 31 last of the Executive Council of the National Institute for the Blind, 224-6-8 Great Portland Street, London, W.1, has recently been issued. The report gives an account of the work of the Institute, with a general description of its activities. Interesting information is given respecting the reproduction of literature in Braille and in Moon types, with several illustrations. Help is given by voluntary workers in the production of single Braille volumes: for example, a particular text-book for a blind student. It is only by means of an assured income that the splendid work of the Institute can be maintained and extended, and an appeal is made for continuous support, for which purpose the annual subscription is most valuable.

THE eleventh Annual Report of the Ministry of Health, 1929–1930, has recently been issued (London: H.M. Stationery Office. 4*s*. 6*d*. net). The report relates to the year ended on Mar. 31, 1930, and the subjects dealt with come under the main heads of public health, local government and local finance, poor law, national health insurance, and contributory pensions. The report is in the main a record of the more important business transacted by the Ministry during the year, and does not cover matters of routine or detail. In the section dealing with sale of foods and drugs, attention is directed to the considerable contamination by tin that may occur in cheeses wrapped in tin-foil. As in previous years, the Annual Report of the Chief Medical Officer of the Ministry is published separately.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A research student at the Institute of Pathology and Research, St. Mary's Hospital—The Secretary, Institute of Pathology and Research, St. Mary's Hospital, Paddington, W.2 (Nov. 17). A lecturer in dermatology in the University of Liverpool—The Registrar, The University, Liverpool (Nov. 19). An assistant at the Institute of Metals, for technical abstracting—The Secretary, Institute of Metals, 36 Victoria Street, S.W.1 (Nov. 20). An assistant curator in the Royal Botanic Gardens, Kew, in charge of the Herbaceous and Alpine Department—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Nov. 24). A principal of the Stranmillis Training College, Belfast—The Secretary, Committee for the Training of Teachers, Ministry of Education, Parliament Buildings, Belfast (Dec. 1). A director of the Fuel Research Institute of the Union of South Africa—The Secretary, Office of the High Commissioner for the Union of South Africa, 73 Strand, W.C.2 (Dec. 15). An advisory entomologist in the University of Reading, under the scheme of the Ministry of Agriculture and Fisheries for the provision of technical advice to farmers—The Registrar, The University, Reading.

Our Astronomical Column.

Total Solar Eclipse of Oct. 21.—The *Daily Science News Bulletin* of Oct. 24, issued by Science Service, Washington, D.C., gives an account of the results obtained by the American party on the island of Niuafo'ou in the solar eclipse of Oct. 21. There had been rain shortly before totality, but it cleared in time, leaving only a very slight haze, which did not seriously interfere with the coronal photographs: these are stated to be of marvellous beauty; they were taken with the 63-ft. tower telescope and the 65-ft. horizontal one. The corona was of a type intermediate between maximum and minimum; there were streamers both to east and west, and a coronal dome shaped "like a gigantic strawberry" was a prominent feature. Prof. Mitchell secured excellent spectrograms with two concave gratings, extending from λ3200 to λ7800. They show more than thirty hydrogen lines and eight coronal lines. Structure can be traced in the image given by a coronal line in the green; a coronal disturbance is shown that appears to be connected with a prominence. The New Zealand party also secured successful spectrograms with a prismatic camera, but they are on a smaller scale than the American ones.

The Leonid Meteors of 1930.—Mr. W. F. Denning writes: "The shower of November meteors becomes due at the middle of the present month, though no brilliant display is to be anticipated. The group of meteors which originated the abundant exhibition of Nov. 13, 1866, was disturbed by the gravitational influence of the planet Jupiter and apparently drawn outside the earth's orbit, so that in 1899 or 1900 no striking returns were observed. In 1901, however, a somewhat plentiful outburst of meteors was noticed in America, while in 1903 the shower was witnessed in England. The numbers counted, however, fell far below those recorded in 1833 or 1866, and were quite of secondary importance. The part of the stream which may return this year will form the region in advance of the main clusters near the cometary nucleus and should be attentively observed, for it is important to ascertain whether or not the meteors are now more richly distributed along the orbit than in former years. This year the moon will be full nine days before the shower should recur with the greatest activity, and will rise on Nov. 15 at 0.34 A.M. and at 1.59 A.M. on Nov. 16. Observers who will watch the firmament either before or after these times will be certain to see a few fine Leonids, and possibly obtain some valuable data."

Research Items.

The Barren-Land Wolf of Canada.—In a recent instalment of his account of "An Expedition to Subarctic Canada" in 1924–25, Capt. J. C. Critchell-Bullock gives a lengthy account of the habits of the barren-land wolf (*Canadian Naturalist*, October 1930). He dismisses as highly exaggerated the stories of the viciousness of these wolves, which, well-fed or starved, always avoid a direct encounter with man. Very few authentic cases are on record of the killing of human beings, and apart from one case of a badly crippled man on the Mackenzie River many years ago, they apply to an occasional Indian or Eskimo child who had become waylaid during a blizzard and had fallen down. In such circumstances, even sleigh dogs at a trading post have been known to maul a woman, with fatal results. The barren-land wolf travels in packs of not more than eight or nine, and it seems reasonable to assume that these packs consist of parent wolves and their own litters. They breed during June, and the pups, generally born in a den amongst loose drift which can be readily tunnelled, are suckled for two months and then fed on meat or partially digested food regurgitated by the mother. At two years they are practically full-grown, and until they take mates, follow their parents. Wolves are not likely to be found breeding in any locality in greater numbers than about one pair to four square miles, and where food was scarcer, dens were found at intervals of about twelve miles. They make great inroads upon the caribou herds, and on the assumption that there are four million caribou in Canada and fifty thousand wolves, the author reckons that the annual kill amounts to some two and a half million caribou.

Control of Moles.—An account of some experiments in the control of moles, carried out by the Department of Agriculture and Horticulture of the University of Bristol, is given in the *Journal of the Ministry of Agriculture*, vol. 37, p. 646. A badly infested area was surrounded by a yard-wide trench, in the inside of which fine wire netting was erected to prevent the escape or re-entry of moles. Certain materials known to be effective in rodent control were used. Baits prepared from red squill, either as a liquid or powder, at the rate of ten parts per hundred of the powder, proved satisfactory, provided that considerable care was taken to avoid handling the soil or disturbing the run, it being found that if the naked hand rubbed the soil of the burrow, or the run was much disturbed, the moles escaped near this point. Gassing with 'cyano-gas' or 'horo-gas' was also effective in driving the moles from the runs; but for satisfactory results the process should also be carried out in the retreats of the moles under banks or in woods, for although the actual runs do not become re-infested after being gassed, the moles will tend to carry on their activities around the treated area. Trapping is considered quite satisfactory in the hands of an experienced person, and is recommended for large estates where there is sufficient work to justify the employment of a professional mole-catcher.

The Butterfly *Pieris rapæ* in New Zealand.—In the *Entomologists' Monthly Magazine* for October (p. 224), Mr. E. S. West records the capture of two examples of this common and destructive butterfly in New Zealand. They were taken in Napier, Hawke's Bay, and the record is one of considerable importance. Under a new and highly favourable environment there is a possibility of the insect establishing itself and becoming as great a pest as in Europe and North America. Doubtlessly the Department of Agriculture and the Cawthron Institute will take any steps desirable to ascertain whether the species has secured a footing or not, and will give advice as to any repression measures, should such prove necessary. The two examples recorded may prove to be merely odd specimens from a small batch that possibly got introduced in the egg stage. It is not unlikely that eggs of this species were present on Cruciferous vegetables in cold store on steamers plying between New Zealand and Honolulu or northern America, where this insect is common. On reaching a New Zealand port, vegetable debris discarded from steamers might provide the means of entry of the insect in question. *Pieris rapæ*, it may be added, has so far been unknown in Australasia. It became established in the Hawaiian Islands less than thirty years ago, where it most likely got introduced from California on cabbages or allied vegetables.

Northern Ostracods.—An account of the Ostracoda of the North Sea and Baltic forms a recent part of "Die Tierwelt der Nord- und Ostsee" (Begründet von G. Grimpe und E. Wagler. Lief. 16, 10 b: Ostracoda von Walter Klie, Bremerhaven. Leipzig: Akademische Verlagsgesellschaft, m.b.H., 1929), numerous species being recorded, but not all differentiated. The systematic part, which takes up rather more than half the memoir, contains diagnoses of the main groups and keys to the genera, with figures, chiefly after G. O. Sars, of representative forms or of their characteristic appendages, 45 genera and 172 species being included. The remaining portion, besides dealing briefly with methods of collecting and technique, is taken up by descriptions of the morphology, physiology, life-histories, and general bionomics of these animals, with notes on habitat and distribution. No mention is made of Prof. H. Graham Cannon's work dealing with important points both of anatomy and feeding mechanisms. Much more is known about freshwater ostracods than of the marine forms, information being very scanty, especially as to the life-histories of the latter. All those in the district described are bottom forms except the Conchoæcidæ and *Philomedes globosus* in the Cypridinidæ, which are pelagic. More workers are much wanted to further our knowledge of the marine ostracods, and they would probably be amply repaid by taking up the subject in detail.

Resistance of Statoblasts to Unfavourable Conditions.—In the course of observations on the statoblasts of the largest of the colonial freshwater Polyzoa, *Pectinatella magnifica*, Chandler M. Brooks made several tests to determine their resistance to unfavourable conditions of temperature and of drought (*Proc. Acad. Nat. Sci. Philadelphia*, vol. 81, p. 427, 1930). It has been generally supposed that the statoblasts of freshwater Polyzoa must be frozen or at least go through a considerable period of rest before they will hatch. Specimens kept at 22° C. until about ready to hatch, hatched under normal conditions although the temperature fell to freezing point, while those not kept in the warm room failed to hatch. Even the lowest temperature produced by an ice and salt mixture did not kill statoblasts exposed to it for any length of time, but even at 10° C. they developed very slowly. Heating above 40° C. retarded development, and at 55° C. death resulted. It would appear, therefore, that statoblasts develop steadily from the time they are formed, just as buds do, but the speed of development is greatly influenced by the temperature, and the

retardation due to excessive cold explains the lack of hatching in autumn. As regards drought, undried statoblasts hatched in eight days ; dried for one week, in twelve days ; for three weeks, in nineteen days ; for five weeks (when they could be broken and ground to dust), in twenty-three days. The polypids are much more sensitive, enduring 10° C. for a short time only and dying at once at 45° C., so that the statoblasts clearly have a positive protective function.

Fruit Storage.—The home storage of apples and pears is an all-important question at this time of the year, and much waste can be avoided if attention is paid to a few general rules supplied by the Ministry of Agriculture. Care in choosing the right time for picking is essential if storage is to be successful. The fruit should come away from the tree easily on gently lifting, every precaution being taken to avoid bruising, as the careful storage of damaged fruit is only trouble wasted. A cool cellar or shed with a good roof and earthen, concrete, or brick floor is best, since wooden-floored buildings, especially dwelling-houses, are apt to be too dry. Pears, however, can be kept under slightly drier conditions than apples. The atmosphere should be rather moist, and during the first three weeks, at least, considerable ventilation is essential. A cool, even temperature is desirable, and the fruit should be kept in complete or partial darkness. Before placing in store, the fruit should be allowed to cool off in an airy place. Each sound specimen is then wrapped in a separate piece of clean tissue paper and they can be packed several rows deep on shelves or in boxes. Pears, in particular, need frequent inspection, as their ripe period is so short-lived. They are best stored spread out in shallow boxes. Wrappers for fruit storage, cut to a convenient size, can be obtained from most horticultural salesmen.

Sugar Beet in England.—The financial results of sugar beet growing in the eastern counties of England have been investigated for the three years 1927–29, and are reported on by C. Burgess and P. E. Graves in Report No. 16, Farm Economics Branch, University of Cambridge, Department of Agriculture. Data have been supplied by one hundred and fifty-two farmers, and more than ten thousand completed forms have been supplied and analysed statistically. The report first gives a statistical rendering of the field data, manuring, yield, sugar content, and soil classes, which provide the theoretical basis for the work. Other factors concerned are the influence of time of delivery upon sugar content, weather conditions during growth, and cost of haulage and transport. After a consideration of the over-all costs and the receipts and profits per acre and per ton, the results are grouped for the different soil types. This leads to the practical aspect of the factors influencing costs and returns, such as manuring, rate of seeding, methods of cultivation, etc., together with the difficulties due to the seasonal distribution of labour required for sugar beet. The second reduction in the rate of subsidy comes into operation with the 1931 crop. There has been a considerable extension in the acreage under sugar beet, but it is considered that it would be unwise to press for too great a reduction on the present price of sugar beet on this score, since maximum production is essential to economic factory operation, and lower prices might entail a reduction of acreage and consequent reduction in supply. It is to the interest of the factory to offer a price which will maintain the acreage of beet at a maximum, and in the interest of the farmer to maintain a high production to enable factories to be run economically, so that the interests of the two parties are in reality identical.

Form of the Japan Arc.—Though the term ' Japan arc ' has been used by Naumann and others for nearly fifty years, no attempt seems to have been made to determine its exact form until the task was undertaken by Mr. N. Kumagai, of the Geological Institute, Kyoto Imperial University (*Jap. Jour. Ast. and Geophys.*, vol. 8, pp. 1-28 ; 1930). The boundaries of the four main islands, Kyusyu, Sikoku, Honsyu, and Hokkaido, are taken to be the bathymetric lines of 200 metres on either side, for at this depth there is an abrupt increase in the slope of the ocean-bed. The central axis of Japan is defined as the locus of points midway between the marginal arcs. The means of every three of the points corresponding to each half-degree were calculated and when plotted on a map were found to lie nearly along the arc of a small circle, the pole of which lies in lat. 42° 37′ N., long. 130° 23′ E., the polar distance of the circle being 8° 46′. In the same way, Mr. Kumagai finds the boundaries of the arc to correspond closely with two parallel small circles, the distance between them being 178 miles, while the total length of the Japan arc, from the west end of Kyusyu to the north end of Hokkaido, is 1300 miles. In a second discussion, the island of Hokkaido is excluded, as its boundaries deviate slightly from the above small circles. It is then found that both boundaries and central axis agree much more closely with parallel small circles, the pole of which is in lat. 41° 0′ N., long. 131° 46′ E., the distance between the marginal arcs being the same as before, and the length of the arc not less than 986 miles.

Granite Intrusions of the Adirondacks.—In the *New York State Museum Bull.* No. 281, 1929, Dr. A. F. Buddington presents the results of five years of field work in the foothills of the north-west Adirondacks, south-east of the St. Lawrence and parallel to it. Here there is a belt of Grenville formations invaded by fourteen elongated granite masses. The latter are interpreted as phacoliths resulting from intrusions of magma in the crests of anticlinal folds with subsequent intense deformation before the complete consolidation of the magma. The granite bodies are restricted to the folds, limbs and noses both presenting conformity with the bedding of the invaded rocks. In one case the base of a phacolith is clearly exposed. On the other hand, there is scarcely a trace of cataclastic structure in the granites and such foliation as occurs is shown to have developed before consolidation. The phenomena to be expected at the surfaces of batholiths are absent. Along much of the contact between granite and limestone there is a narrow zone, up to 150 feet in width, that consists of hornblende- or pyroxene-gneiss, accompanied by sills and lenses of granite and pegmatite and sheets of garnet-sillimanite-gneiss. Metasomatic replacement of limestone by residual solutions carrying volatile compounds thus appears to be indicated.

New Jersey Barnacles.—Mr. Horace G. Richards (*Proceedings of the Academy of Natural Sciences of Philadelphia*, vol. 82, 1930) notes the habitat of several barnacles, particularly *Platylepas hexastylos* on the skull of the green turtle *Chelonia mydas*. This is the first time that this species has been seen *in situ* on a turtle although it was known to live attached to them. The more common turtle barnacle *Chelonibia testudinaria*, which lives attached to the shell of turtles, was found on a large specimen, probably the loggerhead (*Caretta caretta*), taken by a fisherman. The rock barnacle *Balanus balanoides* has recently been found where rock jetties have been built along the sandy shores, although previously absent on account of the uncongenial surroundings. *Balanus eburneus* is the commonest barnacle in these districts.

Mollusca of Jasper Park.—The Jasper National Park, Alberta, Canada, save for the birds and mammals, has been biologically a *terra incognita*, so that advantage was taken of expeditions to the Park in 1925–26 to study as many of the animal groups as possible and Mr. Alan Mozley now reports on the mollusca collected in and around certain of its lakes (*Trans. Roy. Soc. Edinb.*, vol. 56). About forty species and varieties are enumerated and described and some are figured in order to show their typical form and variations in the region, while an account of their habitats and other phases of their ecology is promised in a later communication.

Atmospheric Pollution.—The Report of the Atmospheric Pollution Committee of the Department of Scientific and Industrial Research for the year ending March 1929 was published on Oct. 28. It shows that of the principal towns of Great Britain at which observations of the dust particles which fall to the ground from the air in a month are made, only a few have districts in which the deposit is less than 12·7 tons per square mile per month. These are Bournville and West Heath, Birmingham; Garston, Watford; Headingley, Leeds; Western Park, Leicester; Rothamsted; Hesketh Park, Southport; and Clarence Park, Wakefield. The great majority of the stations, for example, London (including Kew), Cardiff, Edinburgh, Glasgow, Rochdale, Stoke-on-Trent, and the central parts of Leeds, Leicester, Birmingham, and Wakefield have deposits from one to three times, Liverpool, St. Helens, and the centre of Rochdale have from three to five times, while City Road, Newcastle-on-Tyne, has more than five times the above. The average amount of suspended sooty impurity in the air of, for example, London or Stoke-on-Trent on a winter day, is about half a milligram per cubic metre, domestic smoke being 2·5 times as much as industrial smoke in London and 3·5 in Glasgow, while towns like Leeds get about 25 per cent more sunshine in the outskirts than in the centre.

The Boiling Point of Water.—Although the boiling points of water under pressures between 68 cm. and 83 cm. of mercury are generally given to 0·001° C., there are discrepancies of the order of 0·01° C. between the values given by different observers. In order to decide between the alternative values, Messrs. A. Zamaczinsky and A. Bonhoure have made a new series of observations, using the glass hypsometer of M. Swietoslawski, in which the boiling process projects the steam and hot water against the thermometer tube. The temperature is measured by platinum thermometers, the pressure of the atmosphere by a standard barometer, and the deviation from it by a water manometer. To prevent superheating of the water, the inside surface of the hypsometer is covered with powdered glass. The results agree to within 0·002° C. with those given by M. Volet as the result of the observations of Chappuis and referred to in the notice of vol. 18 of the *Travaux et mémoires* of the Bureau International des Poids et Mesures (NATURE, **125**, p. 948). The authors agree with M. Volet that a trinomial in the pressure is necessary to express the results. They give a table of boiling points between 68 cm. and 83 cm. mercury pressure by steps of 0·1 cm. in the September issue of the *Journal de Physique*.

Determination of Unsaturated Hydrocarbons.—*Technical Paper on Fuel Research*, No. 28 (Department of Scientific and Industrial Research. London: H.M. Stationery Office, 1930, 4*d*.), by A. B. Manning and F. M. E. Shepherd, on the determination of aromatic, unsaturated, and naphthene hydrocarbons in light oils and motor spirits, deals principally with light oils from the carbonisation and hydrogenation of coal, only two examples of motor spirit being metnioned. The principle of the method is absorption from vapours, similar to ordinary gas analysis. Further investigation of the application of the methods to petroleum products would undoubtedly be of interest.

Critical Constants of Fluorine.—The boiling point of fluorine was given by Moissan and Dewar in 1897 as approximately – 187°, but no other measurements of the vapour pressure of this element have been made. In the October number of the *Journal of the American Chemical Society*, Cady and Hildebrand describe the preparation of fluorine in quantity and the measurements of its vapour pressure. They calculate the boiling point as – 188·2°, and point out that this is in good agreement with Moissan and Dewar's value corrected to the new values for the vapour pressure of oxygen, which gives – 188·0°. The critical temperature and pressure are found by direct experiments to be approximately – 129·1° and 55 atm., the latent heat of evaporation at the boiling point being 1540 gm. cal. per mol.

An Electrically Driven Sifting Machine.—In the *Chemiker-Zeitung* for Oct. 15 will be found the description of a new electrically driven sifting machine which is likely to be of great use in chemical factories and laboratories. It is made in various sizes and can be adapted to take sieves of different shapes. It can be suspended from above and may be transported along an overhead rail. The vertical motor is enclosed in a dust-proof casing and both it and the container which moves the sieve are mounted on ball-bearings. Shaking is effected by means of an enclosed excentric device, with a special arrangement to guard against transference of any of the vibration to the motor. Any ordinary hand-sieve up to a diameter of 54 cm. can be fixed to the model and readily interchanged. The machine is made by Messrs. A. C. Fraissinet, of Chemnitz.

Furnace Atmospheres and the Production of Scale.—At a joint meeting of the Yorkshire and Fuel Sections of the Society of Chemical Industry held in Leeds on Oct. 27, a paper on the influence of different furnace atmospheres in the heating of metals, particularly steel, by Dr. W. H. Blackburn and Prof. J. W. Cobb, of the Fuel Department, University of Leeds, was read. Typical furnace atmospheres reproduced in the laboratory show that it is of paramount importance that free oxygen should not reach the surface of the hot metal, indicating the necessity of not using more air than is necessary to complete combustion. A fuel rich in carbon and poor in hydrogen, as, for example, dry coke used in a fire or gas-producer blown with air and no steam, produces definitely less scale than a fuel richer in hydrogen, such as oil or bituminous coal. Special experiments showed that the free carbon suspended in the atmosphere of a furnace working with a smoky flame plays little or no part in making that flame protective against scaling, the protection being due to the reducing gases present. There seems thus to be no ground for the common assumption that a smoky flame from bituminous coal is more effective in minimising scale than a clean reducing flame from coke, which latter would, indeed, tend to be more protective on account of its lower content of water vapour. This contention is important in connexion with the possibility of minimising smoke from industrial furnaces.

Furunculosis in Freshwater Fishes.

THE Interim Report issued in March last (Edinburgh: His Majesty's Stationery Office) of the Furunculosis Committee appointed in July 1929, by the Right Hon. William Adamson and the Right Hon. Noel Buxton, contains a large amount of information on the damage done by this disease and the means of its dissemination, with suggestions for its suppression. The Committee was constituted "to investigate the origin, predisposing causes and mode of dissemination of furunculosis and similar infectious diseases among salmon, trout and other freshwater fish in England and Scotland, and to conduct experiments with a view to ascertaining methods of combating the disease, and to report the results of their proceedings".

Previous to the formation of this Committee, much information and experimental data were collected by a smaller and informal committee between the summer of 1928 and July 1929, certain members of which are on the present committee, and the services of Miss I. J. F. Williamson, who has been the research worker throughout, are retained, with a laboratory placed at the disposal of the committee in the Bacteriological Department of the University of Edinburgh, where recently accommodation for live fish has been arranged.

Furunculosis among freshwater fish had been known on the Continent for at least forty years, almost solely on fish farms, later in Bavarian rivers, and in 1910 in France and Switzerland. A severe outbreak in four rivers in the south-west of England in 1911 directed attention to the disease, which had been known in Great Britain, in a much less severe form, probably among trout in the chalk stream, a few years earlier. In 1911 investigations were carried on, and *Bacillus salmonicida*, the same organism as had been found to be the cause in Germany, was identified. Later the disease was recorded from Ireland, Wales, and Scotland and assumed an important aspect.

Furunculosis in the salmon and other freshwater fish is thus caused by the bacterium *Bacillus salmonicida*, which invades the blood stream and is distributed throughout the body. Lesions forming focal areas of necrosis in the skin and underlying muscles are set up, causing death. The bacillus can be isolated and cultivated artificially. It can be present in outwardly healthy fish, these being 'carriers' of the disease. Gobies were infected in the laboratory by these carriers.

The Salmonidæ are chiefly infected, particularly the genus *Salmo*, both *Salmo salar* (salmon) and *Salmo fario* (brown trout) being frequent victims, also other freshwater species to a less degree, but not purely marine forms. The eel, *Anguilla vulgaris*, has been experimentally infected, as have certain other marine fish.

Healthy fish placed in water with infected individuals may contract the disease. Set free in fresh water, the parasite may survive for a sufficient period to allow of its widespread distribution. Outbreaks usually occur from the end of May to October and there is a relative quiescence during winter and spring, but the disease may persist throughout the year in any given area. Thus it is enzootic but may be epizootic. There is no evidence of the passage of the organism through an intermediate host. It may be assumed that infection is spread by contact of infected and healthy fish or by the discharge of the specific organism from the body of infected fish into the water.

Temperature is an important factor, warm dry weather favouring the disease. Overstocking and overcrowding also helps in spreading it to a large extent. All kinds of rivers and streams may harbour it. So far, river pollution seems to be unimportant in favouring its growth.

It is probable that salmon from the sea become rapidly infected in fresh water and the change of environment may increase susceptibility. All evidence favours the theory that infection is introduced into the area concerned by some means other than natural. When once there it may spread by many methods. Possibly infection may come from the introduction of a fish from a farm known to be infected.

It is of immense economic importance for our fisheries to get rid of this disease. In one river when in the ordinary course every fish would spawn, as many as 700 salmon have been picked up dead in a single season, the average annual loss being 400 fish, and the trout fisheries also suffer to a large extent.

The recommendations of the Committee as to means of control are: the collection of further evidence regarding the distribution of the disease; control of all possible sources of infection; eradication of the disease when present in fish farms by destroying the fish and emptying and disinfecting the tank or pond, and the immediate removal of dead and dying fish from the rivers; amelioration of conditions possibly favouring outbreaks when infection is already present, especially overcrowding; the control or prohibition of the importation of live fish from abroad, and the provision of powers to inspect and examine fish from artificial and natural waters, especially fish farms which are the usual sources of stock fish; finally, the maintenance of a central laboratory where routine examination of fish can be carried out and research prosecuted.

Upper Air Investigations in Egypt.

A PUBLICATION entitled "Upper Winds at Cairo and Khartoum", which constitutes Paper No. 27 of the Physical Department of the Ministry of Public Works, Egypt, has been issued. It summarises the results of many thousands of measurements of upper wind made with the aid of pilot balloons at Helwân (25 km. south of Cairo) and Khartoum, the author being L. J. Sutton, director of the Egyptian Meteorological Service. The bulk of the paper is made up of statistical tables showing the frequency of occurrence of winds from the different directions, and the frequency of different speeds from each of the directions at various heights. There are also figures showing the resultant winds in each month at the surface, 500 metres, 1000 metres, and so on up to about 4000 or 5000 metres; and in the case of Khartoum, mean values for the rainy season (May–October) and the dry season (November–April).

The meteorological value of a work of this kind is largely represented by the extent to which it enables a more accurate picture of the general circulation of the atmosphere to be given in standard works on meteorology such as Shaw's recently completed "Manual of Meteorology". The statistics given in this case in regard to the mean wind at 3000 metres and 5000 metres in January at Helwân, agree with a figure in vol. 2 of that manual (Fig. 164, p. 259), in so far as they confirm the existence of a prevailing

westerly wind in northern Egypt at the 4000 metre level, in spite of the dominance of northerly winds from 500 metres to 2000 metres. The resultant at 4000 metres height is not far from due west in any month, and on an average for the whole year must be almost exactly from west.

At Khartoum conditions aloft are complicated by the complete seasonal change occasioned by the northward and southward movements of the equatorial wind circulations in accordance with the varying declination of the sun. In the rainy season the resultant has an easterly component from 3000 to 5000 metres, and is on an average nearly due east between 4000 metres and 5000 metres from July to September. Shaw's "Manual" does not give the mean pressure distribution at 4000 metres in July for the northern hemisphere, so a similar comparison cannot be made for that level. There is, however, a diagram for 8000 metres. If the latter is correct, one would expect light northerly winds to predominate above the easterlies found by Sutton. It is possible that these exist, but it may be noted that Sutton's resultant direction for July backs from nearly north-east to a little south of east, on passing from 4000 metres to 5000 metres, and it appears more probable that the diagram in question (Fig. 167, p. 162 of vol. 2) requires slight modification in view of Sutton's statistics.

In the dry season at Khartoum it appears that westerly or north-westerly winds prevail at about 3000 to 4000 metres, not winds from between west and south-west, as is implied by the figure in Shaw's "Manual" referred to earlier in this notice, which gives the pressure distribution at 4000 metres in January. It may be noted that Teisserenc de Bort is the authority on which Shaw based his diagrams. It is to be hoped that someone will be willing presently to revise our notions of mean air movement at 4000 metres and 8000 metres over Africa in the light of such valuable papers as this, when more of the younger meteorological services have carried on systematic soundings for a long series of years.

Drift Bottle Experiments in the Gulf of Mannar.

MR. A. H. MALPAS, in his work entitled "Preliminary Account of the Results of Drift Bottle Experiments in the Gulf of Mannar" (*Ceylon Journal of Science*—Section C, Fisheries: Bulletin of the Ceylon Fisheries, vol. 4, April 1930), describes the continuation of the experiments initiated by Mr. James Hornell in 1907. The recent researches have been on a much larger scale, drift bottles being liberated, so far as was practicable, throughout the year from 1913 until 1927 (except for the years 1917–19) and the area extended to include the whole of the portion of the Gulf above the Colombo-Tuticorin line, in order to obtain some idea of the monthly current changes.

In the Gulf of Mannar there is a more or less regular cyclic movement of water controlled by the north-east and south-west monsoons. The effect of the south-west monsoon, which has its maximum in July–August, is to force oceanic water of high salinity and low temperature into the Gulf, whilst with the north-east monsoon with its maximum in December–January the surface water is replaced by water of a low salinity. The oceanic current operates chiefly in the southern portion of the Gulf and rarely penetrates so far north as the pearl banks. There is, however, a definite surface drift over the pearl banks area due to the wind, and the banks lack protection from the violence of the south-west monsoon, which at its height makes the waters at the bottom turbid and may cause silting.

Under favourable conditions of south-west monsoon and current in July and August, the pelagic larvæ liberated at Tuticorin might reach Ceylon and settle as spat, and, conversely, Tuticorin might receive spat from Ceylon in December and January during the north-east monsoon.

In analysing the drift for each month of the year, the direction of drift of each bottle recovered is assumed to be from the point of liberation to the point of recovery, and naturally no allowance is made for the various possible changes in direction of drift between liberation and recovery.

The number of recovered bottles during the period of the north-east monsoon was small and these indicate no marked currents in the Gulf opposed to the prevailing north-east winds which would carry the bottles to either the Indian or Ceylon coasts. Many were probably carried out into the ocean and so lost. The period from March to April is transitional between the two monsoons with an average of south-west winds, the returns indicating a change of drift from south-west to north-north-east. In the pearl banks area and up the Ceylon coast the current was northerly with a slight westerly tendency. The 'little monsoon' sets in at the end of April with wind and rain and a pronounced north-east drift. The south-west monsoon from May to October opens with a burst of rain and wind about the middle of May, through June gradually becoming stronger until its full force is reached towards the end of July and beginning of August, then weakens and dies away in October: average wind south-west in May–July, more westerly in August–October. The bottle returns indicate north to north-east drift, becoming more easterly as we proceed north-west across the Gulf.

On the whole, the results of the bottle returns are in agreement with the Admiralty interpretations.

British Archæology.

AMONG the numerous papers on British archæology read before Section H (Anthropology) of the British Association at the recent Bristol meeting, two are of special interest. (1) Mr. C. W. Phillips, in discussing "Earthworks on Walton Common Down, near Clevedon", pointed out the great importance of air photography. On Walton Common Down, 250 feet above sea-level, is a group of earthworks in the form of a roughly circular enclosure 340 feet in diameter, with an entrance on the south-south-west side. An avenue formed by banks of similar construction projects from it 100 yards to the north-east and ends in a cross bank. A disc barrow stands to the north of the avenue and a partially destroyed rhomboidal earthwork to the south.

Until the site had been examined from the air, it was considered that the circle and avenue might be the remains of an ancient sacred place, but air photography proved a wholesome corrective by showing that outlying portions of one of the groups of Celtic fields underlie the earthworks, which are thus subsequent in date. Both air photography and field work show intensive remains of Celtic cultivation on the Common Down, associated with two groups of proved hut circles. It is suggested that the cross bank and avenue might have been devices for marshal-

ling and sorting sheep, similar works in Ireland being known to be thus associated.

(2) Mrs. E. M. Clifford's paper on prehistoric discoveries at Barnwood, Gloucester, opened up possibilities of decisive evidence as to the physical type of the native British who were living in the district when the Roman legions reached Gloucester (Glevum). The site lies by the side of the Roman road leading from Gloucester to Cirencester, It is an extensive flat field two miles distant from the Severn and 80 feet above the level of that river. The field has been excavated to a depth of 8 feet by the Gloucester Stone Company, and the discoveries reported by Mrs. Clifford were made during operations.

A section shows an upper foot of soil, then 2–3 feet of brick-earth, then bedded gravels, upper and lower. The lower gravels are rich in remains of mid-Pleistocene fauna; in the gravels and brick-earths have been found Acheulean, Mousterian, and Aurignacian stone implements. No human remains of Pleistocene date have been discovered as yet, but burials of a later date—of the early bronze age period (a beaker burial), of La Tène II.—and an extensive Roman cemetery (first and second century A.D.) have been carefully examined. In the Roman cemetery more than 100 inhumations and 50 cremations have been studied.

Sir Arthur Keith visited the site after the British Association meetings and considers it to be of great historical importance. He thinks that the evidence points to the people buried in the cemetery as being native British, thus giving a complete picture of the kind of people who lived in the west of Britain when the Romans reached Glevum. Mrs. Clifford acknowledged expert assistance received from Sir Arthur Keith, Mr. J. W. Gray, Prof. L. S. Palmer, the late Dr. C. W. Andrews, and Mr. Reginald A. Smith.

'Serialism.'

THE work entitled "An Experiment with Time", published in 1927, in which numerous remarkable instances were given of dreams that had occurred prior to the occurrence of the events corresponding to them in waking experience, will be familiar to many readers of NATURE. In order to account for these phenomena, the author of the book, Mr. J. W. Dunne, propounded in it a theory, which he designated 'serialism'; and he has recently been giving broadcast talks in further elucidation of his theory.

Mr. Dunne maintains that, so far from being a fallacy, an infinite regress is traceable not only in the nature of physical existence but also in the nature of our awareness of the physical world. The physical world is, he argues, so constituted that it can be viewed as a series of more and more fundamental worlds; and can, in fact, be understood only when examination of it is carried so far as the second term of the series. The process of scientific investigation consists, he urges, essentially of two steps—the search for the truly 'given', or compulsory, elements in our knowledge, and the description of such given knowledge as knowledge of an existing world. The awareness that some of our knowledge is compulsory is itself second-term knowledge. Thus, knowledge of a real external world and knowledge of the self are correlative—both are given in willed activity, primarily the activity of attention. The ultimate will and the ultimate physical entity that is the opposite of will belong to the realm of indefinable 'being', from which the defined fields of physical and psychical existence are to be extracted.

The second-term field of physics exhibits entities of a plainly regressive character; moreover, it does not constitute a closed physical system, but discloses gaps in its continuity, and these gaps indicate where there may be voluntary intervention. If the physical world be described in terms of matter, the regress comes to light when matter is derived from a sub-matter, called space, and this again from a sub-space, and so on.

The most striking confirmation of the theory is, however, afforded, Mr. Dunne thinks, by an analysis of the time regress. If we say of an event that it is happening 'now', we are adding something to the simple notion of a time-order; and the 'now-mark', which characterises the first-term field of physical existence, must itself travel. When, in the series of events *A B C*, *B* is now and later *C* is now, they are earlier and later in a more fundamental time, in which all that is past and future in the lesser time co-exists. In modern physics the importance of the 'now-mark' has, it is contended, become readily apparent; for the probable structure of *B* depends very largely upon *B's* position with regard to a 'now'. Many paths which a particle may take when *A* is 'now' are no longer open when *C* has become 'now'.

University and Educational Intelligence.

CAMBRIDGE.—The Adam Smith Prize has been awarded to Miss R. L. Cohen, of Newnham College, for an essay entitled "Factors affecting the Price of Potatoes in Great Britain".

At St. John's College the following have been elected into fellowships: W. D. V. Hodge, Wrangler with distinction, Part II. Mathematical Tripos 1925, Smith's Prize 1927; J. G. Semple, Wrangler with distinction, Part II. Mathematical Tripos 1927, Rayleigh Prize 1929; P. E. Vernon, Natural Sciences Tripos Part I., 1926, Class 1, Moral Sciences Tripos Part II., 1927, Class 1, Rockefeller Foundation Fellowship in Social Sciences at Yale University 1929.

The Henry Sidgwick Memorial Lecture at Newnham College will be given by Prof. A. V. Hill, professor of physiology in the University of London, on Saturday, Nov. 22, at 5 P.M. The title of the lecture is "Biology in Education".

LEEDS.—Under the will of the late Lord Brotherton, who died on Oct. 21 last, the University is to receive £100,000 for general purposes. This benefaction will be additional to the gift of the University Library, his collection of books, and an endowment for upkeep.

OXFORD.—At the meeting of Congregation on Nov. 4, a decree was passed providing that £2000 of an anonymous gift to the University of £5000 should be invested and the income used for the purchase of scientific books and periodicals. Another decree was passed giving power to the Vice-Chancellor to make provision for carrying on the duties of the Savilian professorship of astronomy during the vacancy caused by the death of Prof. H. H. Turner.

THE Prince of Wales has consented to become president of the fourth Congress of Universities of the Empire to be held in Edinburgh next summer, and, circumstances permitting, to welcome and address the delegates and representatives in London on July 3.

PROF. L. M. DENNIS, of the Department of Chemistry, Cornell University, informs us that the following have accepted appointment to the George Fisher Baker Non-Resident Lectureship in Chemistry at Cornell University for the next two years: first term, 1930–1931, Prof. G. Hevesy, Freiburg in Breisgau; second

term, 1930–1931, Dr. N. V. Sidgwick, Lincoln College, Oxford; first term, 1931–32, Prof. W. L. Bragg, Manchester; second term, 1931–32, Prof. Alfred Stock, Technische Hochschule, Karlsruhe; first term, 1932–33, Prof. Cecil H. Desch, Sheffield; second term, 1932–33, Prof. Otto Hahn, Kaiser Wilhelm Institut für Chemie, Berlin-Dahlem; first term, 1933–34, Prof. V. M. Goldschmidt, Göttingen; second term, 1933–34, Prof. Robert Robinson, Oxford.

Historic Natural Events.

Nov. 16-18, 1928. Storms over British Isles.—This was a very stormy period over the British Isles and neighbouring parts of Europe. A deep barometric depression lay north of Scotland and a series of intense secondaries crossed England and the southern North Sea, bringing winds of nearly 90 miles per hour in gusts. This storm caused much damage, especially to shipping, in Germany and Holland, with some loss of life. In Holland and Schleswig-Holstein the dykes burst in several places, with flooding.

Nov. 17, 1218. Storm Flood in North Sea.—Several parishes were overwhelmed by the sea, and many thousands of persons lost their lives. This storm broke through the West Frisian Islands, and formed the beginning of the Zuyder Zee.

Nov. 17-18, 1852. "Duke of Wellington's Flood".—During one of the highest Thames floods on record, on the occasion of the Duke of Wellington's funeral, the hearse and horses were upset in the flooded Bath Road at Maidenhead. At Putney the towing path was six feet under water, and the Great Western Railway line was flooded for four miles between Hanwell and Paddington. At Windsor part of the Home Park was four feet under water. Oxford was described as standing in a sea of water, the whole of the surrounding country being flooded, and the Evenlode Valley was for more than a week like an immense lake.

Nov. 17, 1882. Sunspot, Magnetic Storm, and Aurora.—A remarkable sunspot, visible to the naked eye, was reported on Nov. 17 and the following days. It was the largest spot hitherto photographed at Greenwich, its area being 2470 millionths of the sun's visible surface, and was exceptionally brilliant. Simultaneously both Europe and North America were visited by a violent magnetic storm, which began on Nov. 11 and reached its climax between 10 h. 30 m. on Nov. 17 and 5 h. 30 m. on Nov. 18. The magnetic declination oscillated rapidly through almost 2°, and the changes of force were correspondingly great and sudden. The whole telegraphic system was disturbed to an extent far exceeding anything previously recorded. Equally remarkable was the display of aurora on the evening of Nov. 17. As observed at the Royal Observatory, Greenwich, it commenced with a bright glow of red light extending from the north and west beyond the zenith, interspersed with pale green phosphorescent light and streamers. At 18 h. 40 m. a very brilliant streak of greenish light about 20° long appeared in the east-north-east and travelled rapidly towards the west. This streak was very widely observed over the British Isles; it passed from horizon to horizon in about six seconds, its height was of the order of 200 miles, and its velocity over a path of 200 miles about 15 miles per second. In North America the aurora was also very brilliant, and about midnight, in Michigan, all the visible heavens, to within 20° of the southern horizon, were covered by straight streamers extending from all parts of the horizon to the zenith, where they formed a boreal crown of blood-red colour.

Nov. 17, 1910. Heavy Rain in Sicily.—As a result of a violent thunderstorm and 'cloudburst', 18·3 in. of rain fell in 24 hours at Riposto, Sicily. This is the heaviest known fall in a day in Europe.

Nov. 18, 1912. Hurricane in Jamaica.—The western part of Jamaica was devastated by a hurricane of remarkable intensity, especially when the lateness of the season is considered. At Negril Point lighthouse the wind reached 120 miles per hour at 2 A.M., after which the anemometer was destroyed; the storm continued to increase in violence for four hours, but no estimate was made of the highest velocity. The rainfall was very heavy, and, where gullies opened on to the coast, many houses were washed away and a number of lives were lost; elsewhere, as at Savanna-la-Mar, the sea swept over the land and destroyed everything, wrecked ships being stranded in the streets.

Nov. 19, 1421. Storm Flood in North Sea.—An extraordinarily great storm flood in the North Sea affected the coasts of Friesland, Holland, and England. Seventy-two towns were submerged and it is said that 100,000 men were killed. As a result of this storm the Zuyder Zee finally reached its present form.

Nov. 19, 1822. Earthquake in Chile.—By this earthquake the greater part of Valparaiso was ruined, while the shock was felt over an area 1200 miles long from north to south. A large tract of the coast, it is said 100 miles in length, was permanently upraised, at Valparaiso by about 3 feet, at Quintero by about 4 feet. Three weeks later, the old bed of the sea was still bare, with beds of oysters and other shell-fish adhering to the rocks. An old wreck near Quintero that before the earthquake could not be reached was afterwards accessible from the land.

Nov. 19, 1824. Inundation at St. Petersburg.—As a result of a violent westerly wind which heaped up the waters of the Baltic in the Gulf of Finland and impeded the flow of the Neva, St. Petersburg suffered from the greatest inundation since the foundation of the city. The waters of the Neva rose 13 ft. 7 in. above the ordinary level, and the whole city except some suburbs was submerged. The damage was aggravated by a frost which followed the flood.

Nov. 19, 1928. Cloud formed by Aeroplane.—A Swiss aviator reached a height of about 33,000 feet in clear air near a thin sheet of cirrus cloud. A definite streak of cirrus formed behind the aeroplane, and persisted from 3.45 P.M. until 4.15 P.M., gradually being distorted by the wind. It was successfully photographed from the ground.

Nov. 19, 1928. High Solar Prominence.—An eruptive solar prominence, the highest on record, was observed at the Kodaikanal Solar Observatory, India, to reach the height of 20′·9 (that is, two-thirds of the sun's diameter or about 570,000 miles) above the sun's chromosphere, when cloud intervened. The brightness of the prominence at so great a height was also remarkable. Comparison of several spectroheliograms taken in calcium light gave the greatest outward velocity of the prominence as nearly 145 miles a second.

Nov. 20, 1242. Floods in England.—Miss Ormerod quotes that "there happened a marvellous tempest of thunder and lightning, and therewith followed such an exceeding rain (which continued many days together) that rivers rose on marvellous heights, and the Thames itself, which seldom riseth or is increased by land floods, passing over the banks, drowned all the country for the space of six miles about Lambeth, so that none might get into Westminster Hall, except they were set on horseback".

Societies and Academies.

LONDON.

Royal Society, Nov. 6.—**W. A. Bone** and **S. G. Hill**: The slow combustion of ethane. The slow interaction of ethane and oxygen in various proportions at 290°-320° C. and pressures between 420 mm. and 780 mm. involves essentially 'chain reactions', preceded by well marked 'induction periods'. Addition of small amounts of third bodies may materially shorten the induction period. The subsequent oxidation then proceeds in a manner consistent with the 'hydroxylation' theory, at a rate dependent chiefly upon the ethane concentration.—**A. Fage** and **W. H. Falkner**: An experimental determination of the intensity of friction on the surface of an aerofoil. Using small surface tubes of the Stanton type, measurements of velocity were taken at distances of 0·002-0·003 in. from the surface, from which the velocity gradients at the surface and the intensities of the surface friction were determined. On each surface the frictional intensity had two maxima, the first associated with laminar flow, and the second with turbulent flow in the boundary layer.—**A. M. Tyndall** and **C. F. Powell**: The mobility of ions in pure gas. In experiments with nitrogen the negative carriers were in every case electrons, but the results with positive ions were variable. Small traces of impurity have a great effect on the mobility of the positive ions. The results are in accordance with the view that a positive ion can capture an electron from a neutral molecule of lower ionisation potential, with a consequent change in the nature of the ion. At pressures of 100 mm. or more, the amount of foreign impurity must be reduced to the order of one part in a million. At present no significance can be attached to any of the values recorded in the literature.—**S. Chapman** and **A. T. Price**: The electric and magnetic state of the interior of the earth. A detailed examination of the currents induced within the earth by the primary outer fields of the daily magnetic variations, and of the storm-time variations of the earth's field during magnetic storms. The induction is supposed to occur within a uniform conducting core of which the upper surface is at a depth of about 250 km. below the earth's surface; evidence is found for a rapid rate of downward increase of electrical conductivity in the layer below 250 km.—**R. H. Fowler**: Speculations concerning the α-, β- and γ-rays of Ra B, C, C′, I. Replacing the ideal Hertzian oscillator in the nucleus used in Miss Swirles's theory by an actual model nuclear quantum-mechanical system, interacting by Coulomb forces with the electrons of the outer atom, shows that there is no likelihood of any serious modification of her calculations so long as the dipole moment of the two nuclear states concerned in the emission of any γ-ray does not vanish. When it does vanish and the nucleus can, practically speaking, not *radiate* this frequency at all, the more correct interaction integral of the revised theory still does not vanish, but survives, operating ejections of the K-(etc.) electron as a β-particle by collision with the nuclear particle, when the K-electron actually enters the nucleus.—**R. Fort** and **C. N. Hinshelwood**: Further investigation on the kinetics of gaseous oxidation reactions. The substances studied were methane, methyl alcohol, and formaldehyde, the two latter being intermediate products in the oxidation of the former. These characteristics of the reactions are best explained by assuming a 'chain' mechanism, which does not seem to depend upon any particular chemical configuration of the reacting molecules, so long as the necessary energy is available. The part played by the walls of the containing vessel depends not only on the dimensions of the vessel but also on the nature of the surface. It seems probable that the adsorbed layer of oxygen may play an important part in breaking the chains which reach the wall.—**C. N. Hinshelwood** and **K. Clusius**: The displacement by ultra-violet light of the explosive limit in a chain reaction. Mixtures of phosphine and oxygen at ordinary temperatures react negligibly slowly except between two sharply defined limits of pressure. In this region explosion occurs, the passage from the slow reaction to explosion being abrupt. Ultra-violet light of wave-length 2500-2800 A. diminishes the lower pressure limit. This effect is shown to be due to the production from the phosphine of a minute amount of an active substance, which does not decay immediately when the illumination ceases.—**C. D. Ellis** and **G. H. Aston**: The absolute intensities and internal conversion coefficients of the γ-rays of Ra B and Ra C. Measurements of the relative intensities of the natural β-ray groups and those liberated from platinum by the absorption of the γ-rays enable the magnitude of the internal conversion coefficient to be deduced. The results appear to be incompatible with a radiation hypothesis of internal conversion and indicate some other type of coupling between the nucleus and electronic system. The experiments provide a method of measuring the absolute intensities of the stronger γ-rays.—**A. A. Robb**: On a symmetrical analysis of conical order and its relation to time-space theory. The time-space geometry of Minkowski and geometries of larger number of dimensions can be built up on a basis of *before* and *after* relations, and congruence can be defined in purely ordinal terms. The importance of such geometries is disguised by the lack of symmetry in the canonical expression for the square of a linear interval. It is now shown that analytical symmetry may be introduced by taking as the canonical form, not a sum of squares, but a sum of products.—**R. A. Fisher**: The moments of the distribution for normal samples of measures of departure from normality. Two methods are given for discussing the distribution of the ratios of the symmetric functions $k_3, k_4, \ldots$ obtained from samples from a normal distribution to the powers of k_2, of the same degree.—**D. H. Bangham** and **N. Fakhoury**: The swelling of charcoal (1). An apparatus is described by which the linear expansion of a charcoal rod can be measured simultaneously with the quantity of adsorbed gas causing it. Expansion seems to result from the pressure exerted by the adsorbed molecules at sharp re-entrant angles in the surface of the adsorbent. The expansion caused by the adsorption of a given quantity of gas increases with the temperature.—**I. Ramakrishna Rao**: The behaviour of water with change of temperature and with addition of electrolytes as studied by the Raman effect. With increasing temperature, the band becomes sharper and shifts towards the short wave-length side, due to changes in the single H_2O, double $(H_2O)_2$, and triple $(H_2O)_3$ molecules. Addition of nitric acid also makes the band narrower. At high concentrations, two sharp, well resolved bands are formed, one attributed to double water molecules and the other to hydrates of the acid.—**E. Rudberg**: Energy losses of electrons in CO and CO_2. Characteristic energy losses suffered by an initially homogeneous beam of electrons sent through the gas at low pressures were determined. The distribution curves for the electrons show several well marked maxima, which are characteristic of the energy levels of the particular kind of molecules under investigation. In the case of carbon monoxide the maxima have been correlated with transitions from the normal state of the molecule to excited states known from the analysis of band spectra belonging to this molecule or to singly ionised

carbon monoxide. Where a maximum has been attributed to a single electronic state, its position with respect to the different possible vibrational levels is in accordance with the Franck-Condon theory.

PARIS.

Academy of Sciences, Oct. 13.—Georges Perrier: The Congress and International Exhibition of Photogrammetry at Zurich, September 1930.—P. Marchal: Observations concerning parthenogenesis and spandry in *Trichogamma*.—B. Cabrera, W. Johner, and A. Piccard: The rate of change of the magnetisation coefficient of water with temperature. Numerous researches on the thermal coefficient of the magnetic susceptibility of water have given results varying from $+0{\cdot}00013$ to $-0{\cdot}0016$. A résumé of the methods and results is given.—S. Carrus: The integration of systems of differential equations.—Georges Calugaréano: A certain system with an infinity of unknowns.—Gaston Julia: Some majorants of the theory of functions.—R. Mazet: Permanent flow with isolated vortices.—J. Ph. Lagrula: A development of the equations of homology, based on the method of dependences.—L. Quevron: Electrical measuring apparatus based on the use of electromagnets: experiments on the delicacy of moving coil instruments, making use of the Bellevue electro-magnet. This magnet gives a field of the order of 30,000 gauss. The deviations read were proportional to the intensity of the current, and a displacement of the spot of light by 1 mm. corresponded to a current of 4×10^{-9} ampere.—L. Goldstein: The statistical evaluation of the energy of Coulomb interaction in a molecule.—Albert Portevin and Pierre Chevenard: The explanation of the complex phenomena observed during the reheating of hypertempered steels.—Mlle. Suzanne Veil: The microphotometric study of Liesegang rings. The Lambert and Chalonge microphotometer with a photoelectric cell was used in these measurements. The square roots of the mutual distances of the rings are in arithmetical progression.—Augustin Boutaric and Jean Bouchard: The flocculation of ferric hydrate sols by various electrolytes and the Schultze-Hardy law. Flocculation of ferric hydroxide sol with the alkaline salts of twenty acids gave results not in agreement with the Schultze-Hardy rule, according to which the flocculating power of an electrolyte should be almost entirely determined by the valency of the active ion.—Clément Duval: Cobalt cobalticarbonate. The compound $Co[Co(CO_3)_3]$ has been isolated, in the form of an olive green powder. The iodine liberated from a solution of potassium iodide shows that all the cobalt is trivalent: ozone gives rise to a percarbonate, $Na[CoCO_4]$.—E. Raymond: The oxidation of benzaldehyde. In a quartz tube and in the dark, pure dry benzaldehyde is not acted upon by pure oxygen. Metallic salts, copper, silver, nickel, cobalt, and especially manganese act as energetic catalysts promoting the oxidation. Stilbene and other ethylene derivatives have the opposite effect.—Charles Dufraisse and Nicolas Drisch: Researches on the dissociable organic oxides. A dibromorubrene. Irradiated in the presence of air, there is rapid decoloration, with the formation of an oxydibromorubrene. The latter gives off oxygen on heating, regenerating the dibromorubrene. The introduction of two atoms of bromine into the molecule of rubrene has not affected the fundamental property of reversible oxidation.—Jacques Bourcart: The stratigraphy of the international zone of Tangiers.—H. Arsandaux: The present eruption of Mt. Pelée.—E. Martin-Sans: Generality of the presence of alkaloids in the Buxaceæ. The presence of alkaloids in this order appears to be general; the chemical and therapeutic properties of these alkaloids have not hitherto been determined.—Hervé Harant: The Chytridineæ, parasites of the kidney of *Etenicella appendiculata*. An attempt at culture.

LENINGRAD.

Academy of Sciences, *Comptes rendus*, No. 9, 1930.—P. Lazarev: The action of carbonic acid on the nervous centres of the eye. Inhaling carbon dioxide in complete darkness produces visible effects, in the shape of bright dots and lines, which disappear after a few seconds; estimations of the adaptation at this time show a strong reduction in the sensitiveness of the eye. This suggests that carbon dioxide affects the nervous centres of vision.—A. Popov: A contribution to the fish fauna of the Crimean coastal waters of the Black Sea. The fauna includes 91 species of fishes and is closely allied to the fauna of the Black Sea near the Caucasian coasts, while differing strongly from that of the north-western part of the Black Sea. A list of the distribution of fishes by biocoenoses is given.—E. Miram: A contribution to the knowledge of Transcaspian Orthoptera. Description of a new genus of crickets, *Philobothrium*, forming a new tribe, Philobotrini, with two species found in the burrows of rodents *Spermophilopsis leptodactylus* and *Gerbillus sp.*; and of *Myrmecophila oculata*, sp. n. from nests of ants, *Myrmecocystes setipes* For. var. *turcomanicus* Em.—P. Schmidt: The Japanese shark *Halaelurus torazame* Tanaka. A re-description of a species possessing a highly peculiar structure of the male claspers, which are provided with about a hundred hooks enabling the male to hold the female during copulation.—S. Nathanson: Movements of the mathematical pendulum in the uniformly variable field of terrestrial gravity. Weighing on balance-scales. Theoretical considerations on the accuracy of weighing.

Comptes rendus, No. 10, 1930.—F. Loewinson-Lessing: New experimental investigations on the permanent magnetisation of rocks on heating. A rock (liparo-dacite) from Piatigorsk manifested a feeble capacity for magnetisation, with the critical point at 500°-600° C., while in the case of basaltic rocks it was at 800°.—D. Beliankin: Furnace scoria on the Kola Peninsula and Novaya Zemlya. A piece of scoria found on the coast of Novaya Zemlya proved to be, according to its composition, of English origin, from the Cleveland area. Another piece, found at the Kola Peninsula, came from Pennsylvanian furnaces. In both cases it appears that the pieces were carried by the Gulf Stream.—S. Černov: The Far Eastern and Chinese tortoises of the genus *Amyda*. *A. schlegeli* Br. and *A. maacki* Br. are only young forms of *A. sinensis* Wieg.—A. K. Mordvilko: The origin of the heterœcy in plant-lice. An analysis of some particular cases of the change of hosts in Aphids.

SYDNEY.

Royal Society of New South Wales, Sept. 3.—Rev. R. T. Wade: The fossil fishes of the Australian Mesozoic rocks. The different groups are dealt with in detail and the information brought up-to-date; the various horizons from which fossil fish have been found are referred to and full lists of fossils given for each locality. Evidence is produced to show that those fossil fish from the St. Peter's quarry, Sydney, previously thought to be of Permian or even Carboniferous age, are really of Triassic age. A detailed description is given of the fossil fish from a new locality at Brookvale, near Manly, New South Wales.

Official Publications Received.

BRITISH.

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1929. Part 2. Pp. iv+80+3 plates. (London: H.M. Stationery Office.) 2s. net.

Supplement to Catalogue of the Ceramic Library. Pp. ii+95. (Stoke-on-Trent: North Staffordshire Technical College.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 68, No. 406, October. Pp. 1233-1368+xxxii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 5, No. 4, October. Pp. 273-361. (Cambridge: At the University Press.) 12s. 6d. net.

The Botanical Society and Exchange Club of the British Isles. Vol. 9, Part 1: Report for 1929. By Dr. G. Claridge Druce. Pp. 218. (Arbroath: T. Buncle and Co.) 10s.

Proceedings of the Society for Psychical Research. Part 115, Vol. 39, October. Pp. 273-304. 2s. 6d. Part 116, Vol. 39, October. Pp. 305-346. 4s. (London.)

Monographs of the Geological Department of the Hunterian Museum, Glasgow University. 4: Reports on Geological Collections from the Coastlands of Kenya Colony. Made by Miss M. McKinnon Wood. With Introduction by Dr. J. W. Gregory and Report on the Ammonites by Dr. L. F. Spath; Report on the other Mesozoic Mollusca and Brachiopods by Dr. J. Weir; Report on the Kainozoic Mollusca by L. R. Cox; Report on the Cheilostomata by Dr. H. D. Thomas; Report on the Echinoidea by Dr. Ethel D. Currie; Report on the Corals by Dr. J. W. Gregory; Report on the Ostracoda and Foraminifera by Mary H. Latham; Report on the Fossil Plants by Dr. S. Williams; Report on Igneous Rocks by Agnes Neilson, and on the Stratigraphy of the Kenya Coastlands and a List of Localities by Meta McKinnon Wood. (Glasgow University Publications, 17.) Pp. vi+232+24 plates. (Glasgow: Jackson, Wylie and Co.)

FOREIGN.

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 28, Part 3: Refutation of the Schütz Law and its Analogous Equations in the Kinetics of Enzymes. By Kenzo Nakajima. Pp. 329-358. (Tokyo: Maruzen Co., Ltd.)

University of Washington Publications in Anthropology. Vol. 3, No. 3: Wishram Ethnography. By Leslie Spier and Edward Sapir. Pp. 151-299. (Seattle, Wash.: University of Washington Press.) 1.50 dollars.

United States Department of Agriculture. Technical Bulletin No. 188: Life History and Habits of the Plum Curcilio in the Georgia Peach Belt. By Oliver I. Snapp. Pp. 91+10 plates. (Washington, D.C.: Government Printing Office.) 25 cents.

Scientific Publications of the Cleveland Museum of Natural History. Vol. 1, No. 2: Observations on some Wyoming Birds. By Arthur B. Fuller and B. P. Bole, Jr. Pp. 37-80+plates 7-16. (Cleveland, Ohio.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 82. The Fishes obtained by Mr. James Bond at Grenada, British West Indies, in 1929. By Henry W. Fowler. Pp. 269-277. Some Specific Criteria in Conus. By Burnett Smith. Pp. 279-288. (Philadelphia.)

Memoirs of the University of California. Vol. 10: A Study of the Phytosaurs, with Description of new Material from Western North America. By Charles L. Camp. Pp. x+174 (6 plates). (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 3.50 dollars.

Yale University Observatory. Catalogue of Bright Stars, containing all Important Data known in June 1930, relating to all Stars brighter than 6.5 Visual Magnitude, and to some fainter ones; with Appendices containing Galactic Co-ordinates and Indices to the Constellations. By Frank Schlesinger. Pp. 6+208. (New Haven, Conn.)

CATALOGUES.

Acriflavine "B.D." Brand, with references also to Euflavine and Proflavine. Pp. 26. (London: The British Drug Houses, Ltd.)

Illustrated Catalogue of a Valuable Country Library, formed in the XVIIth and XVIIIth Centuries. Part 3: Travels and Voyages, English Topography, Classical and Foreign Literature, Art, Science, Medicine; with a Supplement of Scarce and Interesting Books from various Sources. (Sotheran's Price Current of Literature, No. 820.) Pp. 253-396. (London: Henry Sotheran, Ltd.)

Catalogue of Books in all departments of Botany and Gardening, from Early Herbals to Recent Monographs. (No. 178.) Pp. 64. (London: Dulau and Co., Ltd.)

First Editions of English Books, Nineteenth Century to the Present Day. (Catalogue No. 532.) Pp. 58. (London: Francis Edwards, Ltd.)

Diary of Societies.

FRIDAY, NOVEMBER 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—L. H. Thomas: The Slow Contraction or Expansion of a Fluid Sphere.—M. Bronstein: Note on the Temperature Distribution in the Deep Layers of Stellar Atmospheres.—V. C. A. Ferraro: (*a*) Note on the Possible Emission of Electric Currents from the Sun; (*b*) On Recombination in Ionised Streams of Corpuscles from the Sun.—Dr. H. Jeffreys: (*a*) The Resonance Theory of the Origin of the Moon (second paper); (*b*) Convection in Stars.—W. H. McCrea and G. C. McVittie: On the Contraction of the Universe.—R. H. Fowler: The Solutions of Emden's and Similar Differential Equations.—B. M. Peek: Photometric Observations of Nova Persei 1901.—S. Plakidis: Observations of Comet Forbes (1930 *e*) made with the Doridis Reflector of the National Observatory of Athens.—K. Nakamura: On the Observation of Faint Meteors, as experienced in the case of those from the Orbit of Comet Schwassmann-Wachmann, 1930 *d*.—A. Pannekoek: The Theoretical Contours of Absorption Lines.—Prof. E. A. Milne: The Analysis of Stellar Structure.

BIOCHEMICAL SOCIETY (at St. Thomas's Hospital Medical School), at 5.—R. D. Lawrence and R. A. McCance: The Effect of Phloridzin, Thyroid and Adrenaline on the Glycogen Distribution of the Rat.—E. C. Barton-Wright and J. G. Boswell: An Electric Furnace for the Micro-Combustion Method of ter Meulen.—B. C. P. Jansen, H. W. Kinnersley, R. A. Peters, and V. Reader: Curative Activity of Rice Antiberiberi Vitamin.—W. J. N. Burch: Esters of Phosphoric Acid.—R. K. Callow: The Purification of Yeast Ergosterol and the Separation from it of α-Dihydroergosterol.—F. Challenger, L. Klein, and T. K. Walker: A Note on the Mycological Production of Kojic Acid.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: An Account of Col. McCarrison's Experiments in the Production of Urinary Calculi, with an Exhibition of his Specimens.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Bedford College), at 5.30.—Dr. K. M. Wilson: An Attempt at Representing the Rhythms of Poetry Accurately.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.—G. C. Robson: On a Specimen of *Octopus vulgaris* from Indian Seas.—L. R. Cox: On an Abnormal *Navicula* from South Africa.—Dr. F. A. Schilder: The Gisortiidæ of the World.—Prof. A. E. Boycott and C. Diver: Abnormal Forms of *Limnæa peregra* obtained in Artificial Breeding and their Inheritance.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—E. F. Spanner: Disembarkation of Passengers in Emergency at Sea.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—T. I. Illingworth: The Economic Application of Electricity to Space Heating.

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 6.30.—J. A. Macintyre: The Lighting of Offices and Public Buildings.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (jointly with Chemical Engineering Group) (at Armstrong College, Newcastle-upon-Tyne), at 6.30.—W. S. Coates: Caustic Embrittlement.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry, South Wales Section) (at Technical College, Cardiff), at 7.30.—Principal G. Knox: The Chemist and the Coal Industry.

INSTITUTE OF METALS (Sheffield Local Section) (in Applied Science Department, Sheffield University), at 7.30.—Dr. H. Hyman: Unsoundness in Metals.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Annual General Meeting.

SATURDAY, NOVEMBER 15.

BRITISH MYCOLOGICAL SOCIETY (in Botanical Department, University College, London), at 11 A.M.—Prof. A. H. R. Buller and H. J. Brodie: The Development and Function of the Oidia of the Hymenomycetes.—Prof. A. H. R. Buller and Miss Silver E. Dowding: The Dwarf Spores of *Pleurage anserina*.—D. V. Daran: (*a*) Reproductive Processes in the Mucorineæ; (*b*) Studies in the Life History of *Dicranophora*.—Miss E. Green: The Germination of Spores of Ascobolaceæ.—P. H. Harrison: Some Notes on an Interesting Discomycete, *Sclerotinia æstivale* Pollock.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Eastern District) (at Heathfield), at 2.—Discussion on Some Rural Difficulties, W. O. Humphery; Practical Notes on Supervision, G. H. Ockenden.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—A. Hamilton Smith: Some Recent Archæological Work in Italy (2).

MONDAY, NOVEMBER 17.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. P. G. Wakeley: Demonstration of Specimens illustrating the Pathological Conditions of the Spine and Spinal Cord.

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemical Lecture Theatre, Royal College of Science), at 5.10.—C. N. Hinshelwood: Recent Developments in the Study of the Mechanism of Chemical Change.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales—Liverpool—Centre) (jointly with Liverpool Engineering Society) (at University, Liverpool), at 7.—J. J. Denton: Television.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—Sir Herbert Austin: The Future Trend of Automobile Design (Presidential Address).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Prof. H. Dingle: Spectrum Photography.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—A. N. C. Shelley: Public Control of Building: The Position in 1930.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Dr. F. A. Vening Meinesz: By Submarine through the Netherlands East Indies.

HUNTERIAN SOCIETY OF LONDON (at Cutlers' Hall, E.C.), at 9.—Sir David Milne-Watson, W. A. Appleton, Prof. E. L. Collis, Dr. S. Goodall, and others: Discussion on The Place of the Doctor in Industry.

TUESDAY, NOVEMBER 18.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: Two Old Friends of the Royal Institution (1): William Spottiswoode.

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—Sir J. C. Stamp: The National Capital (Inaugural Presidential Address).

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: Report on the Additions to the Society's Menagerie during the month of October 1930.—Dr. F. A. Bather: Resolutions on Zoological Nomenclature passed at the Zoological Congress at Padua, 1930.—J. Brough: On Fossil Fishes from the Karroo System.—Lt.-Col. J. Stephenson: Oligochæta from Burma, Kenya, and other Parts of the World.—I. Thomas: The Structure and Life-History of *Sciara nitidicollis* Meig.—Dr. A. G. Hornyold: The Otoliths of some large Eels from the Lake of Tunis.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.
INSTITUTION OF CIVIL ENGINEERS, at 6.—W. T. Halcrow: The Lochaber Water-Power Scheme.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates' Section) (at Borough Polytechnic), at 7.—E. R. Corke: Boiler Efficiencies.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—G. H. Dannatt: A Londoner's London.
SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at Royal Technical College, Glasgow), at 7.30.—Dr. A. Jaques: Experiences with Blast Furnace Tar.
INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—J. Holmes: The Turbo-Compressor as Supercharger.
SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—T. H. Arnold: Technique of the Developments of Microstructures.
PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—Dr. W. H. Linnell: The Purity, Standards, and Tests of Medicinal Substances (Lecture).
INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre).—G. Rogers: Address.

WEDNESDAY, NOVEMBER 19.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (at Royal Agricultural Hall), at 11 A.M.—T. P. Francis: Modern Treatment and Disposal of Sewage, especially as affecting Trade Wastes.
ROYAL METEOROLOGICAL SOCIETY, at 5.—J. Edmund Clark, I. D. Margary, R. Marshall, and C. J. P. Cave: Report on the Phenological Observations in the British Isles, December 1928 to November 1929.—A. V. Williamson and K. G. T. Clark: The Variability of the Annual Rainfall of India.—A. Moe: The North Sea as a Link between Climate, Plant Growth, and Migration of Birds, in the British Isles and in Norway. Spring near Yarmouth and at Stavanger.
GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. A. Brammall: A Genetic Study of the Dartmoor Granite, with Analyses by Dr. H. F. Harwood.
ROYAL MICROSCOPICAL SOCIETY (at B.M.A. House, Tavistock Square), at 5.30.—R. J. Bracey: A Universal Tube Length and Cover-Glass Correcting Lens System for Use with Microscope Object-Glasses.—Dr. W. E. Cooke and C. F. Hill: Microscopical Studies in Pernicious Anæmia. I. The Hæmoglobiniferous Cells.
INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30.—A. T. Black: Address.
INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales—Liverpool—Centre) (jointly with Liverpool Engineering Society) (at the Temple, Liverpool), at 6.30.—J. E. Nelson: Electrification of Runcorn and District.
INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (jointly with Midland Centres of Institutions of Civil and Mechanical Engineers) (at University, Birmingham), at 7.
SOCIETY OF RADIOGRAPHERS (in Reid-Knox Hall, 32 Welbeck Street), at 7.—Dr. J. Duncan White: Training in Radiography.
INSTITUTION OF AUTOMOBILE ENGINEERS (North-Eastern Centre) (at Metropole Hotel, Leeds), at 7.15.—A. H. Girling: A New Automobile Braking System.
INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—H. Coates and H. J. Norballe: Some Automatic Electric Control Gear Problems.
LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (at Leicester Museum), at 7.30.—G. J. V. Bemrose: Exhibition Evening: Leicestershire Fungi.
ROYAL SOCIETY OF ARTS, at 8.30.—Dr. L. Binyon: Persian Painting.
MEDICAL SOCIETY OF LONDON.—Prof. W. Rothenstein: Painting and the Healing Art (Lloyd Roberts Lecture).

THURSDAY, NOVEMBER 20.

BRITISH WATERWORKS ASSOCIATION (at Agricultural Hall), at 2.30.—R. L. Robinson: The Afforestation of Watersheds.—A. Bebbington: The Land Drainage Act, 1930, in Relation to Rivers Pollution Prevention.—D. F. Worger: The Rural Water Supply Problem.
ROYAL SOCIETY (Special General Meeting), at 4.—At 4.30.—Lord Rayleigh: Iridescent Colours of Birds and Insects.—C. R. Bailey, A. B. D. Cassie, and W. R. Angus: Investigations in the Infra-Red Region of the Spectrum. I., II.—Dr. J. K. Roberts: The Exchange of Energy between Gas Atoms and Solid Surfaces.
LINNEAN SOCIETY OF LONDON, at 5.—R. Gopala Aiyar: An Account of the Development and Breeding Habits of a Brackish-water Polychæt Worm of the genus *Marphysa*.—R. E. Holttum: Malayan Ferns.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. L. C. Martin: Colour Vision (1).
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—G. Bianchi: Some Data concerning Railway Electrification in Italy.
INSTITUTE OF RUBBER INDUSTRY (at Manchester Ltd., Royal Exchange, Manchester), at 7.—G. Martin: The Evaluation of Raw Rubber.
ROYAL AERONAUTICAL SOCIETY (jointly with Institution of Automobile Engineers) (at Royal Society of Arts), at 7.30.—Capt. H. Swan: Recent Developments in Engine Cooling, with Special Reference to Oil Cooling.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-Side Branch) (at Cleveland Scientific and Technical Institute, Middlesbrough), at 7.30.—G. T. Edwards: Ship Repairing.
CHEMICAL SOCIETY, at 8.—Prof. J. Read and R. A. Storey: Piperitone. Part XI. Syntheses of Optically Inactive and Active Piperitylamines, Piperitols, and α-phellandrenes.—Prof. J. Read and W. J. Grubb: Researches in the Menthone Series. Part IX. A New Optical Resolution of dl-menthol and of dl-camphor-10-sulphonic Acid.
INSTITUTE OF METALS (London Local Section) (at Royal School of Mines), at 8.—Dr. R. Seligman: Some Non-Ferrous Metals in Chemical Engineering.
ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Clinical and Laboratory Meeting) (at Hospital for Tropical Diseases, Endsleigh Gardens), at 8.15.—Demonstrations by Sir Aldo Castellani, Sir Thomas Carey Evans and Dr. G. R. Mather Cordiner, Dr. N. H. Fairley, Dr. E. P. Hicks, Col. S. P. James, Dr. G. C. Low, Dr. P. Manson-Bahr, J. F. Marshall, Drs. W. S. Sharpe, H. S. Stannus, Prof. W. Yorke and Dr. D. U. Owen.
BRITISH INSTITUTE OF RADIOLOGY (in Reid-Knox Hall, 32 Welbeck Street), at 8.30.—G. Simon: Diathermy in Pneumonia.—Dr. A. Müller: An X-Ray Generator with a Rotating Water-Cooled Target.

FRIDAY, NOVEMBER 21.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—Dr. K. R. Rao: The Spectrum of Doubly-ionised Arsenic.—Dr. E. T. Paris: The Determination of the Acoustical Characteristics of Singly-resonant Hot-wire Microphones.—Dr. H. C. Bowker: The Effect of Temperature on Spark Potential.—Dr. L. F. Bates: The Curie Point.—Demonstration of an Instrument for Compounding Curves, devised by Dr. Haughton.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens illustrating the Enlargement of the Prostate, with an Account of the Present State of Knowledge concerning the Etiology of the Condition.
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (in Muspratt Lecture Theatre, Liverpool University), at 6.—Dr. J. H. Reid: Nicotine.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—A. Eagle and R. M. Ferguson: The Coefficient of Heat Transfer from Tube to Water in Surface Condensers.
SOCIETY OF DYERS AND COLOURISTS (at Literary and Philosophical Society, Manchester), at 7.—Dr. J. L. Hankey: The Treatment of Aniline Black subsequent to Ageing.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) (Informal Meeting), at 7.—W. H. Clark: A Talk on Lantern Slides.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—R. P. H. Graham: Ancient Clocks and Horological Curiosities.
INSTITUTE OF BREWING (at Institution of Electrical Engineers), at 8.15.—Dr. E. S. Beaven: The Culture of Barley for Brewing.
ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Clinical Meeting.
INSTITUTE OF CHEMISTRY (Leeds Area Section) (at Leeds).—Annual General Meeting.
ASSOCIATION OF ECONOMIC BIOLOGISTS.

SATURDAY, NOVEMBER 22.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. Plunket Greene: What Schubert did for Song.
BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 3.30.—Extraordinary General Meeting.

PUBLIC LECTURES.

FRIDAY, NOVEMBER 14.

BOROUGH POLYTECHNIC INSTITUTE, at 6.30.—Prof. J. T. MacGregor-Morris: Iron, Nickel, and Highly-Permeable Alloys (Armourers and Brasiers' Company Lectures). (Succeeding Lectures on Nov. 21 and 28.)
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.15.—J. H. Coste: The Object and Methods of Sewage Treatment, particularly in relation to Inland Towns and Isolated Institutions (Chadwick Lecture).

SATURDAY, NOVEMBER 15.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. St. George Gray: The Lake Villages of Somerset.

MONDAY, NOVEMBER 17.

KING'S COLLEGE, LONDON, at 5.30.—Prof. B. P. Haigh: Brittle Fracture in Metals (Armourers and Brasiers' Company Lectures). (Succeeding Lectures on Nov. 24 and Dec. 1.)

TUESDAY, NOVEMBER 18.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: Russian Farming and Agriculture.—At 5.30.—Miss Hilda D. Oakley: The Approach to Reality (1): Through Speculative Thought.
GRESHAM COLLEGE, at 6.—A. R. Hinks: Astronomy in Twelve Chapters: a Summary of Recent Advances. (Succeeding Lectures on Nov. 19, 20, and 21.)
UNIVERSITY COLLEGE, LONDON, at 8.15.—Archbishop of York: The Relations between Philosophy and Religion.

WEDNESDAY, NOVEMBER 19.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. A. Massey: The Prevention of Venereal Disease.
BELFAST MUSEUM AND ART GALLERY, at 8.—Prof. S. P. Mercer: The Romance of a Seed.

THURSDAY, NOVEMBER 20.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. Maude E. Kerslake: Contraceptive Problems of Destitute or Injured Women.
KING'S COLLEGE, LONDON, at 5.15.—Miss Theodora Bosanquet: Auguste Comte and the Positive Philosophers.

FRIDAY, NOVEMBER 21.

TOWN HALL, GATESHEAD, at 7.30.—Dr. M. Ray: The Treatment of Rheumatism (Chadwick Lecture).

SATURDAY, NOVEMBER 22.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Norris: A Survey of Costume from Prehistoric Times to the Elizabethan Era.