

Editorial & Publishing Offices :

MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3485

SATURDAY, AUGUST 15, 1936

Vol. 138

Science and Armaments

NOTHING could demonstrate more completely what the Prime Minister recently termed the madness of re-armament than the fact that in the recent debate on defence in the House of Commons, Government spokesmen failed to reply to the two questions which are uppermost in everyone's mind : What is the limit of the expenditure involved, and against whom is the programme directed ? The questions indeed cannot be answered. There is no limit ; and to express one's fears in definite words might well be to start the conflagration universally dreaded. Unless intelligence once again takes control over passion and prejudice in the relations of nations, and force is relegated to its proper function of maintaining law and order, there can be no escape from a conflict which would involve ruin for all. Nor can we hope for peace among nations any more than among individuals if we encourage the view that wrongs cannot or will not be dealt with by reason or persuasion and can only be redressed by force.

Even the staunchest supporter of the present programme of re-armament and defence in Great Britain can scarcely avoid misgivings as to its eventual outcome. Unless at the same time we can ensure that some real attempt is made to eliminate the root causes of international friction and misunderstandings, to control the mischief wrought by economic nationalism, and to secure a settlement of difficult economic and racial questions on a basis of social justice and not of *force majeure*, the attempts to strengthen armaments, however sincerely aimed at national defence, can only bring conflict nearer. Collective security is in fact the only possible form of security to-day. All else is merely a matter of relative insecurity and how soon the crash will be.

The most serious feature of the recent debate was, however, the absence of reference to the imperfection of defence against modern methods of warfare. Responsible technical and scientific opinion is at one in agreeing that any protective measures for the general population against air attack by chemical means is at best imperfect and inadequate, and scientific workers cannot evade their responsibility for warning the population of the limitations of the measures now being considered by the Air Raid Precautions Department of the Home Office. There could be no greater calamity than for the population to be deluded into believing itself to be largely immune from the consequences of such attacks in the event of an outbreak of war. The proposals to transfer part of Woolwich Arsenal to western and northern districts of the country, and to duplicate the coal oil plant at Billingham in South Wales instead of on the same spot, indicate in themselves that the effective defence even of munition centres is problematic.

To this extent, therefore, scientific workers will be in general sympathy with a resolution which was submitted at the meeting of the British Medical Association at Oxford in July. The resolution, however, proceeded further, and recommended the Association to take the initiative with the object of securing the co-operation of the medical profession of all countries to prohibit the manufacture of poison gas. Scientific workers would undoubtedly join in condemning the use of poison gas in conjunction with other forms of warfare as inhuman and degrading to civilization, even though they may doubt whether it is worth while to endorse too hastily proposals to discriminate against one particular kind of warfare.

The impossibility of effective defence measures against chemical warfare for the civil population should not blind us to the difficulty of securing its prohibition if resort was once made to warfare. Events in Abyssinia have demonstrated afresh the impossibility of relying on the pledges to a particular form of warfare when once a nation has broken its general pledge, even under conditions when provocation or retaliation in kind are impossible. Despite this impracticability, which was emphasized by speakers in the discussion at the British Medical Association, an amended resolution was passed which, condemning gas warfare, called on the Council to do everything in its power to secure the co-operation of the medical profession in all countries to prohibit the use of poison gas.

Apart from the serious doubts entertained by authorities as to the practicability of chemical warfare being prohibited, it is even open to doubt whether the restriction of particular methods of warfare is desirable. The very ruthlessness with which war is prosecuted with modern weapons, and the cynical disregard of international obligations or of any standard of humanity or chivalry in the conduct of a campaign, may even prove a gain to mankind in the end if the lesson is learnt that the real problem is that of eliminating and not merely of mitigating warfare. As Sir Henry Thuillier, who during the Great War was Controller of Chemical Warfare, has suggested, the interests of humanity might be better served if the whole populace appreciated in advance that the direct effects of resort to warfare would not be confined to the combatant services.

The lecture to which we refer has now been published in the *Journal of the Royal United Services Institution* for May last, and it will well repay study by all those who are really concerned with constructive efforts to establish peace and co-operation, and to secure the surrender or abatement of these national claims or rights which most hinder the working of a system of collective security and constitute the gravest danger to peace. Sir Henry Thuillier does much to stimulate clear thinking on questions where side issues have so long diverted attention which should have been given to the major question of eliminating the use of war altogether.

Proposals to restrict methods of warfare have arisen from economic considerations, as in regard to the battleship, but much more commonly on humanitarian grounds. In regard to the latter, a clear answer has rarely been given to the funda-

mental questions: Will the proposed restrictions actually reduce the inhumanity of war, and will the agreement be effective? The voluminous discussions which have taken place on chemical warfare, the submarine, the use of tanks, have not led to any general agreement on the answers which should be given. On the contrary, there is abundant evidence of the muddled thinking which Sir Henry Thuillier warns us is a most serious danger to peace and security.

Certain questions have to be frankly faced in any discussion on restrictions if clear thinking is to be ensured. Since all war is indescribably inhumane, is it to the benefit of the human race to try to reduce its inhumanity in two or three minor directions only? Nothing can really lessen its horrors, and it may well be better that the peoples should realize this in order that they may make every effort to put an end to it altogether. If it were known in advance that the effects of warfare would fall as ruthlessly on all classes of civilians, whether on the statesmen who had bungled diplomacy, or financiers or manufacturers or others whose desire for trade expansion or profits had contributed to its outbreak, as on members of the fighting services, much more serious and constructive efforts to prevent it might be made. On the question whether the proposed restrictions could really reduce the inhumanity at all, not only is there need for a close sifting of opinion but also for a frank facing of facts. The desire to abolish submarines or poison gas is largely based on lack of knowledge, false sentimentality, conservatism, fear of unknown methods and perhaps especially the fear that our adversary may prove more efficient in these new methods than ourselves. To the third question, whether we could have a reasonable guarantee that agreements of this sort would not be evaded, or even openly repudiated under stress of defeat, events in Abyssinia suggest a very definite and depressing answer. The only hope seems to be to organize a society in which constructive effort will be used to eliminate war altogether and to make civilized peoples realize the horrors and inhumanity of any such conflict between nations.

It is well that scientific workers should, as was done in the recent discussion at the meeting of the British Medical Association, dissociate themselves from the prostitution of scientific results in warfare or for other nefarious purposes: it is equally their duty, however, to do all in their power to ensure clear thinking on such matters. The

pertinent remarks of Sir Henry Thuillier about the alleged inhumanity of gas warfare, or even of the use of the submarine, should be welcomed by all scientific workers, and they reveal the essential childishness of much of the discussion on this point.

All war is inhumane ; and to fritter away effort discussing the relative inhumanity of different kinds of warfare is rapidly becoming intolerable. What has to be recognized is that war is not only inhumane but also under modern conditions its renunciation as an instrument of national policy, and as a means of dealing with international disputes, is absolutely essential if civilization is to survive.

The question really is whether there is yet time to carry out the constructive work involved both in developing adequate machinery for settling international disputes, and for removing the causes of international friction and misunderstanding, before the world is overwhelmed in another outbreak. Scientific workers owe it to themselves, no less than to their science and to their civic responsibilities, to strain every effort to ensure constructive thinking in these matters and to promote the formulation and execution of policies adequate to secure that the enormous powers now at our disposal are used for the advantage of mankind instead of its destruction.

A Sketch of World History

World History :

the Growth of Western Civilization. By R. Flenley and W. N. Weech. Pp. xix+757. (London : J. M. Dent and Sons, Ltd., 1936.) 12s. 6d. net.

WORKS on general history have often been noticed in *NATURE*, especially from the point of view of the space and the position which they assign to science. There has undoubtedly been a marked improvement in the matter, and the very attractive book under notice is a good example, suggesting also one or two points of criticism in its presentation. It is certainly the best thing of the sort that we have seen in English—a sketch of world history in some seven hundred pages with abundant illustrations and excellent maps and diagrams and written throughout by both authors with full knowledge and an almost perfect impartiality.

The questions of how to present the vast mass of material, and for whom one is writing, are, in this kind of book, supremely difficult. In this one, the readers who will gain most from it are those who have a fairly good knowledge beforehand and are glad to have it revived in a well-ordered summary up to date. For students who are approaching the subject for the first time, the language, ideas and implications of the writers are probably too difficult. This is the case more especially with Mr. Flenley, who does the modern portion. One often feels that the essential points could be conveyed without such an array of long and abstract words and in shorter sentences. On the other hand, Mr. Flenley grapples valiantly with the problem of including all sides of history—music, art and literature as well as science—and his allowance for science is relatively generous. Yet even so, how

can one excuse in such a survey the complete omission of the marvels discovered in the heavens and presented so clearly in the Astronomer Royal's recent "Worlds Without End" ?

Mr. Weech, who is an old schoolmaster, has a crisper and simpler style. Some of his short sayings are admirable ; for example, "It was the spoken word, not the written, that counted with the Greek and made him the teacher of the western world. . . . He was an excitable, quarrelsome, kind-hearted creature. He was continually fighting his neighbour in the next valley, but when he had finished, he did not, like other conquerors, mutilate, crucify or scalp his captives, nor did he convert them into gladiators." On the other hand, Mr. Weech is much less adequate in his account of ancient science. The wonderful discoveries which have recently been made of the mathematics of Babylonia, and the medicine of ancient Egypt, find no place. The institution of the calendar is naturally mentioned, but not its connexion with the heliacal rising of Sirius. More should have been given of the sort of matter which Prof. Gordon Childe has just put out in his "Man Makes Himself"—the origins of civilization—even if further cuts had to be made in the political sections. It is also doubtful in the later portion whether the Impressionist and Post-Impressionist painters deserve the several pages which they get.

There is room, however, for wide difference of opinion as to such relative values, and the book is strongly to be commended in the sense mentioned above. The sober hopefulness of the "Conclusion"—after a summary of the successes and failures of the League of Nations—hits the mark very well.

F. S. MARVIN.

Classical Dynamics

Theoretical Mechanics :

Dynamics of Rigid Bodies. By Prof. William Duncan MacMillan. Pp. xiii + 478. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 36s.

WITH the publication of this volume on rigid dynamics, Prof. MacMillan has completed a task of first-rate importance. This work, together with its companion volumes on statics and particle dynamics and on the theory of the potential, constitute a trilogy which, for a long time to come, will be welcomed by successive generations of honours students of physics and of engineering. Despite the fact that the centre of interest has in some measure shifted from such studies, there was a real lack of a treatise which should serve the needs of this generation as Routh served those of an elder line of students. Routh's works, and Thomson and Tait, have become classics, and as is the fate of most classics are rather read about than read. No more brilliant introductions to the advanced study of mechanics are to be found than those of Horace Lamb. It is rare indeed to find a first-rate intellect which combines an almost unexampled power of exposition with a sympathetic appreciation of the needs of the average student and a capacity for keeping mathematics in touch with physical reality. Lamb had these gifts in full measure, and his treatises on mechanics are an invaluable expression of these gifts.

But a work was needed which should carry the story farther and should view the subject from a rather different angle, and Prof. MacMillan's book fulfils this want. His treatment is severely classical; "the three laws of motion as given by Newton furnish the foundation for the entire structure"; and the section 'E' of the author index contains but the names of Eisenhart and of Euler. Both the geometrical and the purely analytical methods of attack are developed, and the author's preliminary account of the algebra of vectors is a model of clarity and of compression.

A chapter on moments of inertia follows, and here, perhaps, a digression on a point of very elementary, and yet of very general interest, may be permitted. The author defines the moment of inertia of a system of particles *with respect to a plane, line or point* as the "sum of the products of the mass of the particle into the square of the perpendicular distance of the particle from the plane, line, or point (or merely the square of the

distance in the case of a point)". In doing so he has followed the example of Routh and of other classics. But many authors and teachers seem to be obsessed by the notion that the term *moment of inertia* has no meaning apart from an *axis*. Hence they lose the chance of developing that most instructive method of calculating the moment of inertia of a sphere about a diameter, which consists in calculating it *about the centre* by the simplest of all integrations—that of $4\pi r^2 \rho \cdot dr \cdot r^2$ through the volume of the sphere, hence leading to $\frac{3}{5}Ma^2$ as the required value. The moment of inertia (I) about a diameter follows at once from the consideration that I_x is equal to $\Sigma m(y^2 + z^2)$ with two similar (and equal) expressions for I_y and I_z . Hence, by addition, we arrive at the value $\frac{3}{5}Ma^2$ with no more equipment than is required for the integration of $x^n \cdot dx$ and for a knowledge of the geometry of a common brick. This simple method is obviously the one to be followed in elementary teaching. Which of the heroes who lived before Agamemnon invented it, the reviewer knows not, and would like to know; Binet (*teste* Routh) introduced the notion of moment of inertia with respect to a *plane* so far back as 1813.

The chapter on moments of inertia is followed by a series of chapters which deal with systems of free particles, general theorems on the motion of a rigid body, motion parallel to a fixed plane, the motion of a rigid body in space, integrable cases of motion about a fixed point, rolling motion and impulsive forces. This portion of the volume extends to some three hundred pages.

The hundred and seventy pages that remain are devoted to three important chapters, the first of which deals with Lagrangian equations, their application to holonomic systems and their extension to non-holonomic systems. The chapter closes with a brief account of Appell's equations, which are applicable equally to holonomic or to non-holonomic systems.

The penultimate chapter deals with the canonical equations of Hamilton, and the work closes with a discussion of the method of periodic solutions. Here, as in the more elementary parts of the book, the author extends a helping hand to the student by giving him a very clear résumé of the amount of matrix theory necessary for the comprehension of the argument. This chapter, one of the most interesting in the volume, deals with a method of attack which is both long and difficult, but which, as was remarked by its originator,

H. Poincaré, "is the only worth-while method that is known for a wide class of problems".

The book is by no means an easy one to read, but the difficulties which the reader will encounter are inherent in the subject. The author has the teacher's instincts, and has made the going as smooth as may be. Further, he has provided a large number of illustrative examples, of all degrees of difficulty, on which the student may try his hand.

If a word of general criticism be permitted, it is

that the book would be considerably improved if its subject matter were more fully illustrated by examples taken from physical and engineering practice. True, the billiard ball, the top and the pendulum play a large part in the illustrations in the text, but the practical side of pendulum work is drawn from Routh, and in this, as in many other instances, examples are better studied in the light of modern practical work of precision.

The book fills a gap in the literature and may be heartily commended. A. F.

Mineral Resources of the French Colonies

Les ressources minérales de la France d'outre-mer

Publications du Bureau d'Études géologiques et Minières coloniales. 3: Le zinc, le plomb, l'argent, le cuivre, l'or, les minerais radioactifs, le mica, les pierres précieuses, substances diverses. Pp. ii+394+5 plates. 40 francs. 4: Le phosphate. Pp. ii+207+3 plates. 20 francs. (Paris: Société d'Éditions Géographiques, Maritimes et Coloniales, 1935.)

THE issue of these two volumes on French colonial mineral resources by the Bureau d'Études Géologique et Minières Coloniales will be welcomed by readers who have already made themselves acquainted with vol. 1 on coal and vol. 2 on iron ore.

Vol. 3 covers a number of important metals and minerals, including zinc, lead and silver by F. Blondel, copper by P. Lion, gold by P. Delaître, radioactive minerals by H. Buttgenbach, mica by P. Chomette, precious stones by A. Lacroix, and various other metals and minerals, namely, aluminium, asbestos, antimony, arsenic, barytes, diatomite, mercury, nitrate, platinum, pyrite, rock-salt, potash and mineral waters, by F. Blondel.

As the lead-zinc ore deposits of French North Africa may be regarded as forming a Mediterranean circuit with those of Spain and Italy, M. Blondel includes all three in a useful account of the lead-zinc ore deposits of the western Mediterranean generally. On the whole, this region is one of much importance from the point of view of the supply of these base metals. M. Blondel concludes this section by a statistical account in which he examines the national position in France as regards supplies of lead and zinc.

The importance of copper in modern industry, the large necessary imports and very small production in France, makes M. Lion's account of

the French position as regards copper one of much interest. Of considerable interest also is his description of the geology of the copper deposits of the Niara basin to the west of Brazzaville in French Equatorial Africa, and his account of the economics of copper from the historical point of view as well as with regard to the present position.

In the section on gold, M. Delaître gives an account of the geology and distribution of gold in the French colonies, and explains the simpler methods of exploitation applicable by prospectors in opening up superficial deposits in newly-discovered gold areas. In a brief section on radioactive minerals, M. Buttgenbach mentions deposits other than those of the French colonies, and gives a very useful description of the important deposit of uraninite (pitchblende) and its alteration products at Chinkolobwe in the Belgian Congo. In the section on mica, M. Chomette deals with mica generally, but briefly, and refers particularly to Madagascar deposits of muscovite and phlogopite, of which the latter are the more important. Madagascar produces phlogopite of superior quality and appears to have large reserves.

The section on French colonial occurrences of gemstones by M. Lacroix makes an attractive feature, chiefly on account of the remarkable assortment of beryl, tourmaline and other minerals of gem quality in Madagascar pegmatites, which are especially interesting from the mineralogical and petrological points of view. It is interesting to read in this section of the doubts that were entertained up to about a century ago as to whether diamonds really existed in Africa. Since then, Africa, especially South Africa, has produced nearly all the world's diamonds; but it is a very curious fact that, although important discoveries of exploitable diamond deposits have been made in recent years in the Belgian Congo, Angola,

South-West Africa Territory, Tanganyika, Gold Coast and Sierra Leone, no find of any importance has hitherto been recorded in French Africa. No diamonds have been found in Madagascar, and the occurrences in French Equatorial Africa are as yet of no economic importance.

In the closing section of vol. 3, M. Blondel states that the auriferous stibnite mine at Lucette in Mayenne, France, became exhausted and was closed in 1934, a reminder to us, if one be needed, of the wasting nature of the earth's mineral assets.

In vol. 4, which is devoted entirely to phosphate, the important deposits of phosphate in Morocco are accounted for by A. Beaugé, who deals with their geology and explains the working of the organization of the Office Chérifien des Phosphates; and E. Lenhardt, who deals with methods of exploitation and transport.

A separate section is devoted to Algeria and Tunis by P. Reufflet, and another to the marketing of phosphates by H. de Bailliencourt-Courcol. In another section, A. Lacroix deals with phosphatized land-surface deposits such as those due to the replacement of limestones by the action of solutions arising from leached coverings of guano, and corresponding aluminium phosphates formed by the action of similar solutions on trachytes and other igneous rocks.

Not the least interesting section of this volume from a scientific point of view is the one given to a discussion of the origin of sedimentary phosphate beds of marine origin by L. Cayeux. These beds

have been formed at intervals from the earliest geological times, and on account of their importance as a source of phosphate fertilizers may be regarded as among the front-rank mineral resources from the point of view of human welfare. The problem of their origin is a puzzling one. M. Cayeux has long held the view that the formation of marine phosphate beds could only take place after a disturbance of the equilibrium of the sea floor. To this *sine qua non* of sea-floor disturbance, he now adds bacterial action as essential. In some way or other, which is not clear, the bacteria are roused from a state of dormancy to one of action by the disturbance of the sea floor, and set about elaborating phosphoric acid from the sea water, while phosphoric acid attacks any calcium carbonate that may be available, forming calcium phosphate. In this environment, he tells us, fish may flourish abundantly, and the accumulation of their remains is added to that of the phosphate deposited on the sea floor; but the extent to which they contribute is very variable. To the question "Are phosphate beds now forming on the sea-floor?" M. Cayeux replies very emphatically in the negative, and claims that the conditions essential for their formation do not exist at the present day.

Both volumes are well illustrated and indexed, are provided with useful bibliographies, and are likely to be serviceable for many years as works of reference on French colonial resources of the minerals with which they deal.

Formulæ of Medieval Painters

The Materials of Medieval Painting

By Daniel V. Thompson. Pp. 239. (London: George Allen and Unwin, Ltd., 1936.) 7s. 6d. net.

MR. DANIEL THOMPSON has been engaged for many years in the study of the large number of medieval MSS. containing recipes for carriers, grounds, pigments and mediums which are to be found in the libraries, both in Great Britain and elsewhere in Europe. The actual number of MSS. examined amounts to 157, and in this simply written book we have the outcome of a laborious research, involving problems in translation, and the testing out of many recipes in the laboratory and the studio.

Mr. Thompson has already given us the most perfect text of Cennino Cennini's book on painting and an excellent translation, a book on tempera painting which was the result of many years

practice based on Cennino Cennini, and many other contributions to the literature of the subject, and this is his latest contribution. Those who wish to look further into the subject will find in *Speculum* of October, 1935, references to actual MSS. and recipes.

A German scholar would have doubtless written many fat volumes on the material collected by Mr. Thompson, and it is to be hoped that he will still undertake this work. In the meantime, this book, based on a course of lectures given in the Courtauld Institute, enables the connoisseur, artist and collector to obtain the distilled essence of his researches in an easily read and simple form. The classical work on the subject is "The Ancient Practice of Painting" by Mrs. Merrifield, and since then excellent editions of special MSS. have been made. Ernest Berger published certain MSS. in his learned volumes on the history of painting,

and we have from Wilhelm Theobald an excellent edition of Theophilus, and there are others.

Valuable as these publications are, they have two defects. Many valuable recipes may be missed, and too much importance may be given to a single recipe. By making a critical examination and comparison of a large number of MSS. which have so far been neglected, not only are new recipes discovered, but so wide a survey also results in a more trustworthy judgment of what was the actual practice.

It is perhaps unnecessary to say that a book like this starts as many questions as it answers. The paragraphs dealing with verdigris alone, for the preparation of which many recipes exist, call for an investigation into organic basic salts of copper and their properties as pigments. The absence of recipes for certain pigments is also of interest. A copper resinate made by dissolving

verdigris in a pine oleoresin was used so early as the close of the eighth century, yet no recipe has yet been found earlier than that given by Dr. Mayerne in the seventeenth century.

Very few recipes, and those of little value, are given for the preparation of madder lakes, yet fine madder lakes which have stood remarkably the test of time are found so early as the late fifteenth century, and it is difficult to decide how they can have been prepared. The use of madder as a dye was confined to certain dyers in Marseilles, and they may have possessed secrets which were unknown to the painter.

The publication of this book is singularly opportune, when we have at last in the Courtauld Institute a laboratory equipped for research on these lines. Mr. Thompson has provided for this work with a rich mine of material.

A. P. LAURIE.

Vasodilator Substances in Animal Tissues

Gefässerweiternde Stoffe der Gewebe

Von Prof. J. H. Gaddum. Eingeleitet von H. H. Dale. (Monographien zur Pharmakologie und experimentellen Therapie, herausgegeben von Philipp Ellinger.) Pp. xii+200. (Leipzig: Georg Thieme, 1936.) 18 gold marks.

THE basic problem can be stated by pointing out that in the animal body there is a central mechanism for cutting off the blood supply to the different organs; but, so far as present knowledge goes, no central mechanism for increasing it. How then is an active organ, for example, a particular group of muscles in the leg, to obtain a greater blood supply than it received when resting? It was formerly believed that the liberation of acid as the result of tissue activity caused local vasodilatation; it is now thought that vasodilatation follows the liberation of various bases such as histamine, adenosine and others not yet identified.

The old and the new views are linked by the probability that the actual liberation of the bases is a secondary consequence of acid formation. Not, be it observed, that the problem has been recognized and attacked as a problem directly. A series of attempts have rather been made to isolate from tissue extracts substances responsible for various physiological properties possessed by these extracts. Just as biochemical progress has come from the identification of substances having

a characteristic colour reaction, so by identifying substances having a characteristic vasodilator reaction, pharmacological progress has followed. This work is both difficult and laborious and demands much experience of the pitfalls of pharmacological analysis. Prof. Gaddum's book is an extremely valuable account of the chemical and pharmacological properties of the substances which have hitherto been investigated. A great part has been the work of Sir Henry Dale and his very able collaborators, and it is due to his persistence that the subject has been extended so as to throw light on many other aspects of physiology. A stimulating introduction comes from Sir Henry's pen.

The book deals in succession with histamine, acetylcholine, adenosine and then with substances of unknown composition. The author then strains the title by including a chapter on the chemical transmission of nervous impulses, but this will be perhaps its most useful feature to those not working in the special field. The book is a fitting testimonial to Prof. Gaddum. Nothing seems omitted, opinion is not withheld, and when given it is fully supported by evidence; the writing is modest and precise. The best tribute one can pay to the German translation by Dr. Feldberg is that it is very easy to read, but one may make the comment that it is strange to find in German the first general account of work so largely done in Great Britain.

J. H. B.

A Text-Book of Inorganic Chemistry

Edited by Dr. J. Newton Friend. (Griffin's Scientific Text-Books.) Vol. 11: Organometallic Compounds. Part 3: Derivatives of Phosphorus, Antimony and Bismuth. By Archibald Edwin Goddard. Pp. xxviii+318. (London: Charles Griffin and Co., Ltd., 1936.) 20s. net.

VOL. 11 of Dr. Friend's "Text-book of Inorganic Chemistry" deals with organometallic compounds, and the author is Dr. Goddard. It is divided into four parts, the first dealing with derivatives of elements of Groups I to IV of the Periodic Classification of the elements, and the second part with derivatives of arsenic. The present volume describes the organometallic derivatives of the other elements of Group V, namely, phosphorus, antimony and bismuth, leaving the elements of Groups VI-VIII for Part 4, now in preparation.

The book under review is planned on simple lines. Thus the first two chapters deal with fatty and aromatic derivatives of phosphorus, followed by a chapter on miscellaneous phosphorus compounds; fatty and aromatic compounds of antimony, and organometallic derivatives of bismuth are described in the remaining chapters of the book. Of these six chapters, the last two deal with groups of compounds which have formed the subject of original researches by the author.

The wide range of the subject is shown by the fact that reference is made to 2,600 derivatives of phosphorus, 700 of antimony, and 100 of bismuth. The most interesting chapter is perhaps the one which deals with the miscellaneous compounds of phosphorus, since, when this element is used in the form of chloride to bring about a simple replacement of OH by Cl or $>O$ by Cl_2 , it often gives rise instead to addition compounds, which can then be hydrolyzed to phosphinic acids. In this and similar ways the chemistry of phosphorus is extended, until it almost begins to bear comparison with that of nitrogen, with which it is also associated as an essential element of plant and animal life.

This important group of organic compounds has been dealt with by Dr. Goddard in the same efficient manner in which Dr. Sidgwick described the organic derivatives of nitrogen, in a volume which has unfortunately been out of print for some years. By doing so, he has not merely contributed an additional volume to a well-known text-book, but also has earned the gratitude of his colleagues by giving (perhaps for the first time) an adequate account of an unfamiliar section of organic chemistry.

The Medicine-Man of the American Indian and his Cultural Background

By Prof. William Thomas Corlett. Pp. ix+369+14 plates. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall and Cox, 1935.) 22s. 6d.

AN unfortunate currency given to the popular term 'medicine man' to designate the shaman or priest-magician of the Amerindian tribes has given rise to much misunderstanding as to the true function of

this important figure in the Indian social organism. Although the healing art comes within his province, his theory and practice are based on psychology and theology rather than on pathology and pharmacology. In fact, the cure of disease is not his primary function, but an incidental of his relation to the spirit world, in which he acts as the tribal specialist and go-between. Apart from the sweat-house, and a not very extensive acquaintance with simples, magic, which does not differ in essentials from the practices of other parts of the world, is the beginning and end of his diagnosis and treatment. The medicine man, like the shaman of the north-eastern tribes of Asia, to whom indeed he is closely related in many of his functions and attributes, is the spiritual guide of the tribe and its leader in emergency, in many instances holding a position analogous to that of the war chief.

Notwithstanding the basic identity of the conception of the medicine man's function throughout the North American tribes, there is no little variation in detail, both in the position they hold and in their methods of action. Dr. Corlett's purpose has been to place before his readers a conspectus of the evidence and to demonstrate the variations to be found in passing from one to any other of the areas of cultural differentiation into which the Indians of North America have been classified by anthropologists.

The Phenomena of Polymerisation and Condensation: a General Discussion held by the Faraday Society, September 1935. Pp. vi+412. (London and Edinburgh: Published for the Faraday Society by Gurney and Jackson, 1936.) 22s. 6d. net.

THIS publication records the first symposium in Great Britain specially convened to deal with fundamental aspects of polymers, among which synthetic resins and rubber are important industrial examples. The volume will naturally appeal to those workers on plastics who appreciate the importance of a knowledge of the principles underlying formation of their products.

The first section employs the weapons of X-ray spectrography, mechanical properties and kinetics of chain formation in elucidating structures, and is concerned with general concepts of polymeride formation. In general, the latter term is used in the modern sense to imply substances containing repeated units of definite structure not necessarily identical with the starting materials. An attempt by Dr. W. H. Carothers to connect, in a mathematical manner, polyfunctionality with polymer formation, and a study by Dr. K. Meyer of an inorganic polymer from phosphonitrilic chloride, deserve special mention.

The second section contains more specific cases, among which is a most suggestive contribution by Dr. H. Staudinger on the so-called 'insoluble polystyrene'. Although papers on phenol-aldehyde, amide-aldehyde and acetylene products are included, it is an unfortunate, but perhaps unavoidable necessity, that gives such prominence to polystyrene, at the expense of those more complex materials which have formed of late years the basis of industrial plastics development.

N. J. L. M.

An Introduction to Contemporary German Philosophy
By Dr. W. Brock. Pp. xx+144. (Cambridge: At the University Press, 1935.) 6s. net.

THE study of German thought, which has been so popular in Great Britain, has been encouraged lately by the introduction of German philosophy as an optional subject in the syllabus of a first degree in German in the University of London. The interest taken by this University in German studies is further exemplified by its invitation to Dr. Brock to give a course of lectures on German contemporary thought. The book under notice is a direct result of this invitation.

German humanism and the development of the separate sciences are considered to be the background of contemporary German philosophy. Two new philosophical movements have asserted themselves since Hegel: the first covers the numerous attempts towards a philosophical synthesis of scientific results, and the second concerns epistemological inquiries. Then Nietzsche and Kierkegaard have cast their shadow over subsequent thinkers as well as over their contemporaries. These Dr. Brock considers in turn with an objective though sympathetic mind. But their conflicting conclusions leave still undecided the position of philosophy among the determining factors in human life. It would have been interesting to analyse the intellectual factors which have brought German thought to that peculiar position in which it has to renounce its very freedom of action and expression.

T. G.

Kursus der Kristallometrie

Von Prof. Dr. Victor Goldschmidt. Aus dem Nachlass herausgegeben von Dr. Hans Himmel und Dr. Karl Müller. Pp. viii+167. (Berlin: Gebrüder Borntraeger, 1934.) 10 gold marks.

THIS is essentially a practical guide to crystal measurement, drawing and calculation based on the established methods of the Victor Goldschmidt school of crystallography.

Following the general introduction, which deals with the various methods of projection, single-circle goniometry, illustrated mainly by the Penfield contact goniometer, is simply described and two examples are given. This section occupies six pages.

The remainder of the book is devoted to two-circle goniometry and is divided into two parts. Part 1, which provides an admirable introduction to the methods, deals with the two-circle contact goniometer designed by the author. The procedure involved in crystal measurement, drawing and calculation together with the preparation of crystal models is fully discussed and examples from each of the six systems are given in full. Part 2 illustrates the use of the two-circle reflection goniometer and provides examples of more advanced studies of simple and twinned crystals.

This posthumous work of the late Prof. V. Goldschmidt bears the characteristic marks of care and attention to detail which all his work illustrated, and is a very complete and lucid guide to the crystallographic methods evolved in great part by the author.

Die Fermente und ihre Wirkungen

Von Prof. Dr. Carl Oppenheimer. Supplement, Lief. 4 (Band 1, Spezieller Teil: Haupt-Teil 9-12). Pp. 481-640. (Den Haag: W. Junk, 1936.) 28s.

THE fourth part of this work has appeared with commendable punctuality. It deals with the polyases, which are the enzymes which split the complex carbohydrates, the nucleases, the amidases and the first sections of the proteases.

Now that we possess at least an approximate knowledge of the structure of the more complex carbohydrates, it should be possible to make progress also in regard to the enzymes which attack them: for example, the increasing study of the polyfructoses, of which there are apparently several besides inulin, may teach something about inulase. The same applies to such enzymes as lichenase, chitinase, cytase and pectinase, and this section, which gives also a brief indication of the latest views in regard to the structural formulæ of these polysaccharides, will be found to be stimulating.

Recent work has more or less cleared up the structure of the nucleic acids: their appropriate enzymes either convert the acids into nucleotides or these latter into nucleosides and phosphoric acid, or effect the final degradation of the nucleosides into a base and a sugar: there is still much to learn about these and the way in which they work.

The amidases are those enzymes which break the bond between carbon and nitrogen as, for example, in adenine and guanine. They include arginase, of which a good deal is known, also those enzymes which hydrolyze acid amides and lastly urease.

The protein section is of an introductory character.

Grundlagen der Quantenmechanik

Von Dr. H. Dänzer. (Wissenschaftliche Forschungsberichte: Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 35.) Pp. xi+163. (Dresden und Leipzig: Theodor Steinkopff, 1935.) 12 gold marks.

THIS brief but excellent introduction to quantum mechanics is likely to appeal much more to the mathematician than to the experimental physicist, for, as its title suggests, it deals rather with the fundamental ideas than with the applications of wave-mechanics to special problems. The treatment really assumes that the reader possesses a fairly good knowledge of mathematics, and the book should find a welcome from teachers of mathematical physics.

La spectroscopie appliquée

Par P. Swings. (Bibliothèque scientifique belge.) Pp. 188. (Paris: Hermann et Cie., 1935.) 15 francs.

ALL who are interested in the teaching or practice of spectroscopy will find this well-written and informative little volume of interest. In particular, the common errors which are encountered in connexion with spectroscope adjustments are discussed in some detail. The advantages and disadvantages of the various sources of light are also well considered, and it is clear that the author has made a profound study of the contemporary literature of the subject.

Cereals of Ancient Egypt and Mesopotamia

By Prof. John Percival

THE origin of civilization is intimately connected with man's discovery of the cultivation of the cereal crops, the grain of which has formed the most important part of the diet of civilized people from the earliest times down to the present day.

It requires but little reflection to realize that the lives of the millions of inhabitants of the villages and towns throughout the world to-day are dependent upon the unceasing toil of the farmer; were he to discontinue his efforts, the congested humanity of our great centres of population could not exist very long. It is, indeed, no exaggeration to say that the total loss of the cultivated crops of one, or at most, two seasons all over the world, would wipe out the greater part of the human race, and leave the towns and all they contain silent and derelict; the farmer is truly worthy of more respect and sympathy than he usually gets.

Who were the first farmers, where did they live and what were the crops which they grew, are questions of fascinating interest on which light is

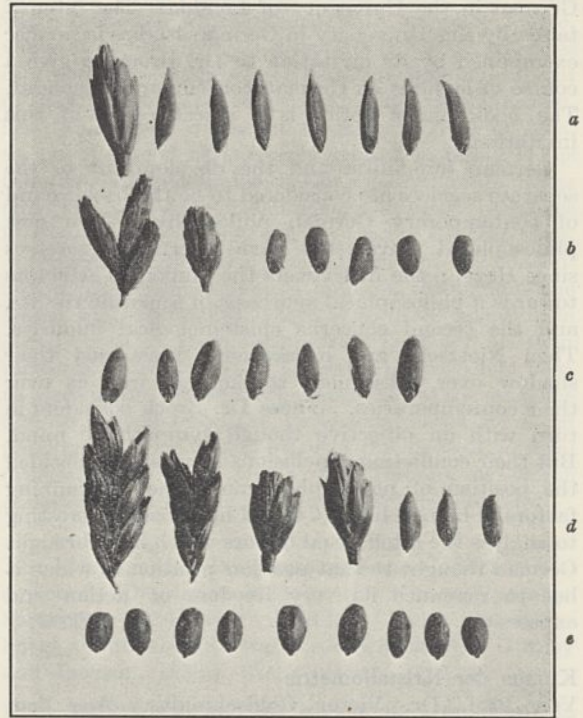


Fig. 2. *a*, Spikelet and grains of Abyssinian Emmer. *b*, Part of ear, spikelet and grains of Badarian Emmer, from Mostagedda (? 5000 B.C.) (Mr. Guy Brunton). *c*, Badarian grains of Emmer from Mostagedda. *d*, Portion of ears, spikelets and grain of pre-dynastic Emmer, from the Fayum desert. *e*, Naked wheat grains from pre-dynastic Fayum site (Miss Caton-Thompson) (all natural size).



FIG. 1. *a*, Ear of modern Abyssinian Emmer, with spikelet. *b*, Ear of Bere barley, with triplet of single-grained spikelets (about half natural size).

being thrown by the patient researches of archaeologists. Historic records of man's activities take us back some four or five thousand years, at which time village settlements and towns were already established in Egypt and parts of Mesopotamia. Samples of the kind of grain forming, as now, the chief portion of the diet of the people, have been unearthed, and it is to these that I now refer.

From the earliest times in Egypt and in Mesopotamia, two kinds of cereal grains were cultivated, namely, wheat and barley. The wheat which was grown was a kind or race of this cereal known as Emmer (*Triticum dicoccum*). It was a very primitive kind of wheat, with flat ears having long awns or beards, like those of present-day barley (Fig. 1, *a*). Ears of Emmer when thrashed break up into short spikelets (Fig. 1), each of which contains two grains closely invested by the glumes or chaff, so much so that the naked grains for consumption can only be obtained free from the chaff by pounding the spikelets with a long pole

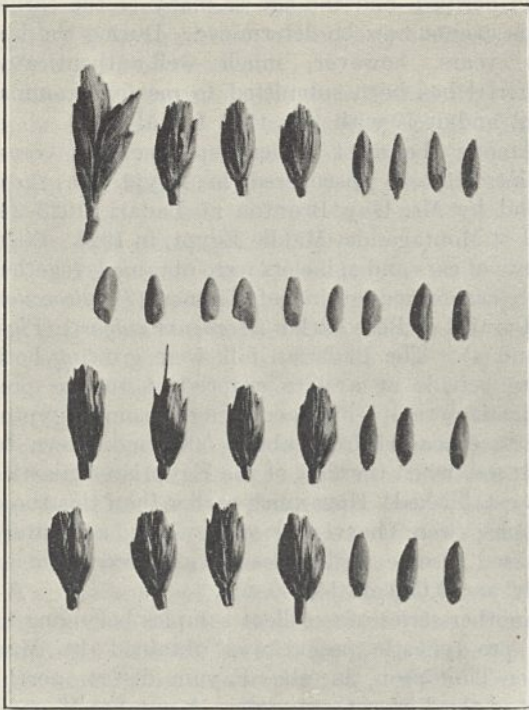


FIG. 3. *a*, Portion of ear, spikelets and grains of Emmer, from tomb of third dynasty, inside enclosure wall of step pyramid of Sakkara (about 3000 B.C.). *b*, Naked Emmer grains from underground gallery magazine, north side of Sakkara pyramid. *c*, Spikelets and grains of Emmer, from tomb of Tutankhamun (about 1400 B.C.). *d*, Spikelets and grains of Emmer from tomb of Eighteenth Dynasty (about 1500 B.C.) (all natural size).

in a kind of wooden mortar. The naked grains are narrow and pointed at each end, much narrower and less plump than the ordinary wheat of our fields to-day.

Emmer is still cultivated for human food in Abyssinia, parts of Russia and India, and in smaller amounts in north-west Persia, Serbia, south-west Germany and the Basque provinces of Spain. It is remarkable that many of the varieties of Emmer still grown are exactly similar in their specific characters to those cultivated by the most ancient Egyptians.

In addition to Emmer (*T. dicoccum*), several other different species of wheat are known with brittle ears which break up readily into short spikelets when thrashed; these are classed together as 'spelt' wheats, 'spelt' being in this case a generic term. Unfortunately, one of these has the specific name "Spelt" given to it, being called Spelt or Large Spelt (English), *Spelz* or *Dinkel* (German), *Epeautre* (French); its botanical name is *Triticum Spelta*. This wheat is a comparatively modern kind, quite unknown to the ancient people of Egypt, but Egyptologists in particular have frequently fallen into the error of translating the Egyptian term for Emmer by the word "spelt" and adding to it the name *Triticum Spelta* instead of *T. dicoccum*.

The ears of the other cereal, barley, are differently constructed from those of Emmer. In barley, three single-flowered spikelets grow close together on opposite sides of the axis of the ear; there are thus six longitudinal rows of spikelets. In the so-called two-rowed barley commonly grown in the fields of Great Britain, only the central flower of each triplet produces grain, giving rise to an ear with two opposite rows of grain. In Bere barley (*Hordeum vulgare*) and Six-rowed barley (*H. hexatichon*), all the flowers of the triplet of spikelets are fertile, and an ear with six rows of grain is produced.

All these kinds of barley are grown at the present time, the two latter being most frequently cultivated in Egypt and other countries bordering the Mediterranean. Both Bere and Six-rowed barley were cultivated in ancient Egypt and smaller amounts of the two-rowed form.

Whether the cultivation of Emmer preceded that of barley or vice versa has been the subject of controversy. A wild kind of Emmer grows in Syria, Palestine and regions near the Caucasus, and is generally accompanied by wild barley. Since there is no character in either which would suggest a preference for one of them, it would appear likely that both were selected contemporaneously by the first cultivators, probably

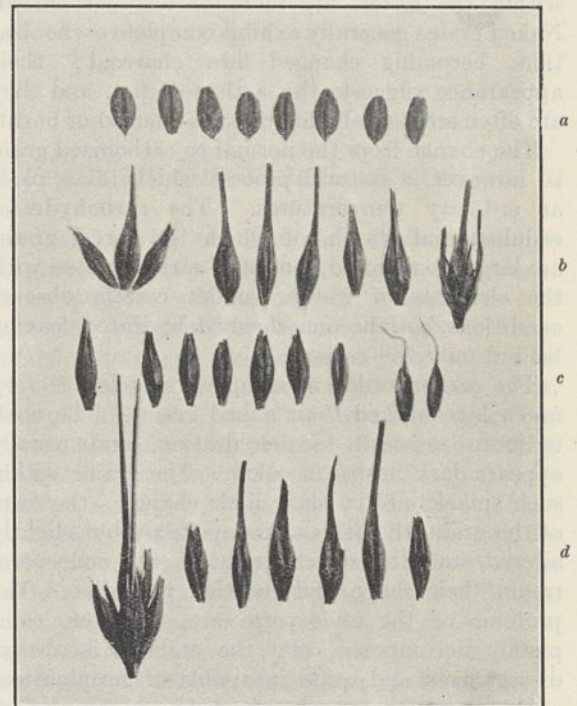


FIG. 4. *a*, Pre-Dynastic carbonized grains of barley, Fayum desert. *b*, Triplet of grains of Bere barley, single grains, and spikelet of two-rowed barley (?) Pre-Dynastic, from the Fayum desert. *c*, Grains of barley, and two 'seeds' of darnel (*Lolium temulentum*), from tomb of Third Dynasty, inside north enclosure of the step pyramid of Sakkara (about 3000 B.C.). *d*, Spikelets of barley of Eleventh Dynasty (Gebelien) (all natural size).

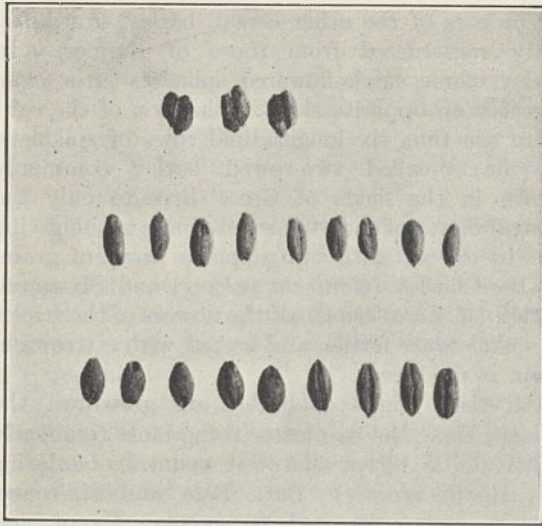


FIG. 5. *a*, Carbonized grains of three spikelets of Emmer, from grain room at Arpachiyah, near Nineveh (about 4000 B.C.). *b*, Carbonized grains of Emmer, and *c*, carbonized grains of barley from the same source (Mr. M. E. L. Mallowen, 1933) (all natural size).

thousands of years before the large-scale farmers of the Egyptian dynastic periods. This view is supported by the fact that mixtures of Emmer and barley, and separate samples of the two, have been found dating from the earliest times.

All these ancient grains, whether taken from underground pits, storehouses, tombs or vessels within the latter, are more or less carbonized. Naked grains generally exhibit complete carbonization, becoming changed into charcoal; their appearance suggests the action of fire, and they are often erroneously described as charred or burnt.

The change from the normal to carbonized grain is, however, a natural process which takes place at ordinary temperatures. The carbohydrates cellulose and starch, of which the cereal grains are largely composed, consist of carbon united with the elements of water; under certain obscure conditions, both become slowly dehydrated, leaving behind only the carbon.

The carbonization of complete spikelets is very much less marked than naked grains. The chaff is more resistant to dehydration, and usually appears dark brown in colour. The grains within such spikelets often show little change; the form of the grain, the hairs at its apex, are but slightly altered, and the starch grains in the endosperm retain their shape and reaction to iodine. The proteins of the endosperm are, however, completely decomposed, and the embryo is always disorganized and quite incapable of germination.

For more than a hundred years, samples of wheat and barley have been taken from tombs in Egypt, but only within comparatively recent times have trustworthy records been made of the archæological horizon from which the samples have

been derived, and the age of many of the earlier finds cannot now be determined. During the last few years, however, much well-authenticated material has been submitted to me for examination, and it is with this that I deal here.

Among the most ancient specimens of cereal grains hitherto discovered in Egypt are those found by Mr. Guy Brunton at Badari (1923-34) and at Montagadda, Middle Egypt, in 1928. Fragments of ears and spikelets were obtained, together with carbonized grains of Emmer (*T. dicoccum*) and grains of Bere barley (*Hordeum vulgare*) (Figs. 2 and 4). The Badarian folk were growing both these cereals at a date antecedent to the pre-dynastic period, which according to some Egyptologists extended from about 5000 B.C. down to 3400 B.C. when the first of the Egyptian dynasties was established. How much earlier than this these samples were harvested cannot be accurately assessed; some authorities have placed them as early as 10,000 or 15,000 B.C.

Another series of excellent samples belonging to the pre-dynastic period was obtained by Miss Caton-Thompson, in the Fayum desert, north-west of the Birket Qurun lake. A number of small straw-lined granaries or pits was discovered, in several of which were portions of typical ears of Emmer with grains (Fig. 2, *d*), as well as grains of Bere barley (Fig. 4, *b*). In some of the pits were found completely carbonized grains shorter and plumper than those of typical Emmer. Whether these are modified Emmer grains cannot be definitely settled, for the exact determination of the species of cereal grains when carbonized presents great difficulty, since the amount of

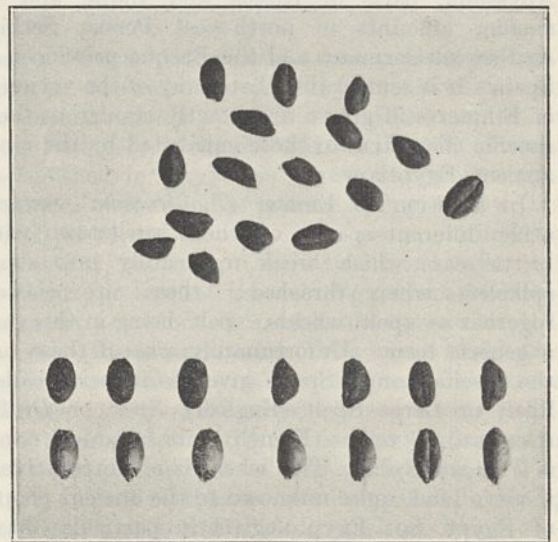


FIG. 6. Upper group: random sample of grains of wheat from a vase on the site of a Sumerian house at Jemdet Nasr, near Kish (3500 B.C.) (Prof. Langdon). First row of lower group: selected carbonized grains from the sample. Second row of lower group: grains of modern Rivet wheat (*Triticum turgidum*) (natural size).

change in the size and form of the grains which appears in some cases to accompany carbonization is not accurately known.

Very numerous examples of grain from Egyptian tombs of later date are available (Fig. 3). These are invariably samples of Emmer and barley, and for several thousand years down to the end of the dynastic period, no other form of wheat than Emmer was cultivated in Egypt.

The dryness of Egypt has greatly contributed to the excellent preservation of all kinds of objects. In Mesopotamia, however, the other great centre of early civilization, the climate and damp soil have led to the destruction of most cereal grains and other plant remains, and very few specimens of grain from this region have been recovered.

From literary evidence, Hrozny concluded that the two chief cereals of ancient Babylonia were Emmer and barley, exactly as in Egypt, Emmer predominating at the earlier dates.

Two samples of great importance have been submitted to me for examination. One of these was found in 1933 by Mr. M. E. L. Malloven in a granary during excavations of a prehistoric site at Arpachiyah, four miles east of Nineveh. Carbonized grains of barley, and a primitive, small type of Emmer were present (Fig. 5). These are the earliest grains hitherto discovered in Mesopotamia, belonging to a period 4000 B.C. or earlier. The other sample, sent by Prof. S. Langdon, of

Oxford, was taken by Mr. Henry Field (U.S.A.) in 1926, from a vase on the site of an ancient Sumerian house at Jemdet Nasr, a few miles north of Kish.

Only grains of wheat were present, and these completely carbonized. They were of large average size, with blunt tips and the prominent dorsal hump characteristic of varieties of Rivet wheat (*Triticum turgidum*) (Fig. 6) which belongs to the Emmer group. I gave an account of the sample in NATURE of February 19, 1927. I consider that these grains represent an advance on the earliest forms of Emmer, resembling some superior types of Emmer now grown in Abyssinia, which are sometimes classed as Rivet wheats.

Mr. O. F. Phillips (U.S.A.) has expressed the opinion that these Kish grains are a kind of Club wheat (*Triticum compactum*), but I unhesitatingly regard this view as erroneous. There is no evidence that any wheat of the bread wheat group to which Club wheat belongs was known in any part of the world for some thousands of years after the date attributed to the Kish sample.

Mr. Henry Field records the discovery of barley grains at Jamdet Nasr, but these I have not seen.

It is hoped that archaeologists will look for and carefully preserve all samples of grain which they may unearth in the investigation, paying special heed to fragments of ears and chaff, for these are of importance in the correct determination of the race or species to which they belong.

Biogeography and Ecology of North African Birds and Mammals

THE animal population of the northern parts of the African continent is of exceptional interest to a biologist, both by reason of the great similarity of the conditions in coastal areas to those of southern Europe, and by the striking contrast provided by the Sahara, with its extreme desert regime and highly peculiar fauna. While the fauna of North Africa in its entirety remains still very inadequately explored, our knowledge of at least two groups, birds and mammals, is sufficiently advanced for a comprehensive survey of the fauna. Such a survey is provided in a recent memoir by M. Henri Heim de Balsac*, who has based it not only on all the available literature, but also on personal explorations carried out over many years.

A careful analysis of the mammalian population of the coastal and mountainous Berberian zone reveals the somewhat unexpected fact that its

relationship with the European fauna is not so close as is usually assumed. Apart from bats, three quarters of the species composing the Berberian mammalian fauna cannot be considered European, and are mostly Ethiopian in origin. Bats in this respect approach the birds, among which the majority are European; but there is a considerable proportion of unmistakable tropical forms. Since palæontological studies have shown a still lower proportion of European forms in North Africa in the earlier stages of the Quaternary period, it appears impossible to retain the idea of any post-Pliocene connexion of Europe with Africa. On the other hand, an exchange of populations with palæartic Asia, through Libya and Egypt, must have existed until the middle of the Quaternary (Rissian) period. The Atlantic islands (Azores, Madeira, Canaries) are populated by relics of the Tertiary Mediterranean fauna, and did not play any prominent part in the origin of the Quaternary fauna of Berberia.

* Biogéographie des Mammifères et des Oiseaux de l'Afrique du Nord. (Supplément xxi au *Bulletin Biologique de France et de Belgique*.) Pp. 447+7 plates. (Paris: Press Universitaires, 1936.) 125 francs.

The northern limit of the Saharan zone depends on humidity, and the isohyet of 200 mm. per annum coincides almost exactly with the limits of the distribution of the desert fauna. The mammalian fauna of the Sahara is almost entirely tropical, mostly Ethiopian, in its origin, and even amongst birds the vast majority are non-palæartic. It is, therefore, impossible to continue to include Sahara in the Palæartic region, as is usually done.

A number of urgent problems of desert ecology are discussed in the second part of the memoir, comprising twelve chapters. There is a mass of original information, often leading to deductions which may be unorthodox, but are well supported by first-hand evidence. The distribution of mammals is very little influenced by the absence of water, since all of them are able to do without drinking, being satisfied with the water obtained from food. The same, however, is observed in mammals elsewhere, and cannot be considered as a special physiological adaptation. Among birds, only a few grain-feeding species (*Pteroclidæ*, etc.) cannot live without drinking, while all those with mixed diet can do so. No special adaptations exist in desert mammals for protection against powerful insolation, since the vast majority of them are nocturnal in their habits, and many pass the day underground. In birds, which are exposed to the sun, no special adaptations in behaviour have been noted.

As regards morphological adaptations to desert environment, some of the classical text-book examples do not withstand serious criticism. Thus, a statistical study of the structure of the feet in desert mammals and birds shows that, contrary

to accepted opinion, there is no special dominant type of structure which can be regarded as adaptation to the environment. On the contrary, there is a great variety of structures, and some of them appear to be singularly ill-adapted to the particular habitat. Similarly, the hypertrophy of external ears considered by many authors as a typical feature of desert animals is actually not a general feature. As regards the great development of bullæ tympanicæ observed in the large majority of desert mammals, it appears to be a real response to the environment, but its physiological and biological significance is wholly obscure, and various hypotheses as to its presumed role rest on a desire to prove its usefulness to the animal, rather than on facts.

Again, a thorough discussion of the vexed problem of the coloration of desert animals does not permit the author to subscribe to its classical explanation as a protective device developed by selection. Both the hypertrophy of the bullæ tympanicæ in desert mammals, and the dilution of pigments, with the preponderance of phæomelanines and almost complete absence of carotinoids, are regarded by the author as characters which developed in strict dependence on the dryness of the environment, acting on the organism either directly, or indirectly.

Every ecologist and general biologist will find in this memoir, the contents of which are very inadequately expressed by its modest title, a store of original ideas, supported by abundant and fresh data of biogeographical, ecological, anatomical and physiological order.

B. P. UVAROV.

Blackpool Meeting of the British Association

ALL signs point to a full and interesting meeting of the British Association on September 9-16 in its new surroundings. The work of the Association, wide enough in all conscience, has been, of recent years, taking on a still wider character. The man of science is realizing to-day, as he never realized before, that he is, as man of science, a citizen of a great community; that he is a power in that community; and that he can forge weapons of a potency, for good and ill, such as the world has never yet known. The destinies of the future civilizations are in his hands, more than in those of any other class; and it is for him to see that the knowledge which he presents so freely to his fellows is used for weal, and not for ill.

To that end, it is necessary to study, critically and minutely, the effects of the advances of science on the well-being of the community. Most of us are content to indulge in that study, so long as it is a matter of handing out bouquets; but the gifts of man to mankind may be evil as well as good, and it is precisely those possibilities of evil which demand most careful study. The new policy of the Association, of starring in its programme those items which deal with aspects of knowledge the repercussions of which on the welfare of the community are direct and important, marks an important step in the history of the Association; it is to be hoped that it will remain a permanent feature of the programme.

The subject of the presidential address (the

impact of science on society), the titles of the sectional presidential addresses, and the principal topics of discussion have already been announced in an article which appeared in *NATURE* of May 9 (p. 766). To these we may now add the series of public lectures and lectures to children. The series is as follows:

PUBLIC LECTURES.

- Lytham St. Annes.* Dr. Olaf Bloch: "The Scope of Photography".
Blackpool South. Dr. W. F. Bewley: "Science and the Glass-house Industry".
Preston. Prof. J. L. Myres: "Who were the Greeks?"
Southport. Sir James Jeans: "Some Recent Advances in Astronomy".
Poulton-le-Fylde. Mr. P. A. Francis: "Applications of Science to Poultry Farming".
Fleetwood. Prof. C. M. Yonge: "Common Shore Animals".
Thornton Cleveleys. Dr. D. F. Harris: "Joy in Scientific Discovery".
Preston. Prof. Allan Ferguson: "Splashes and what they Teach".

LECTURES TO SCHOOL CHILDREN.

- Brigadier H. S. L. Winterbotham: "How Maps are Made".
 Mr. D. Seth Smith: "Favourites of the London Zoo".

Evidently the public lecture, whether to a senior or to a junior audience, is becoming an increasingly important feature of the annual meeting. It is possible that this impressive list of lectures is still incomplete, as applications are

still coming in from some of the East Lancashire towns.

The Evening Discourses, to be delivered by Mr. C. C. Paterson and by Capt. F. Kingdon Ward, will deal with "Science and Electric Lighting" and with "Plant-hunting and Exploration in Tibet". These discourses are open to members only.

Some of the sectional excursions and the social events have already been announced. The Mayor and Mayoress of Blackpool (Alderman W. Newman and Miss Newman) invite members to a reception in the Winter Gardens on Thursday, September 10. The headmaster of Rossall School (Mr. H. G. M. Clarke) will entertain four hundred members at a garden party at the School on Tuesday, September 15. The Rotary Club will hold a luncheon on Thursday, September 10, when the president will address the members and their guests. The Official Service will be held at St. John's Parish Church on Sunday, September 13, when the Right Reverend the Lord Bishop of Blackburn will preach the sermon.

Thirty sectional excursions and visits have been arranged, of geological, botanical, antiquarian, engineering and educational interest. Their range in space is as wide as their range in subject. A visit to the Amusement Park stands cheek by jowl with an excursion to the Lake District, and a visit to the open-air swimming bath hard by an excursion to Garstang, Furness Abbey and the Southport Sand Dunes, Stonyhurst and Rossall, Fleetwood Fish Docks and the Fylde Farms. The members of the Association will indeed have enlarged their experiences by the time that the annual meeting draws to its close.

Obituary

Sir Henry Wellcome, F.R.S.

EARLY on the morning of Saturday, July 25, there passed away, at the ripe age of eighty-two years, a unique personality, whose activities ranged from archaeological and geographical exploration to the creation of a great manufacturing business, and whose interests included such diverse matters as the collection of ancient manuscripts, the social welfare of native races and the provision of funds for fundamental research in those sciences on which the progress of medicine depends.

Sir Henry Wellcome was born in Wisconsin and, as the son of a frontier missionary, spent his childhood among Dakota Indian tribes. A boy whose earliest experiences included that of organizing the casting

of rifle bullets for the defence of a settlement of whites, and of assisting his uncle—a well-known frontier surgeon—in treating the wounded in the Sioux War in Minnesota, was obviously well-equipped for an interesting career. He chose pharmaceutical chemistry as a vocation, and passed a period of study in Chicago and Philadelphia, where he took his diploma. His life-long interest in travel began to show itself at this stage, and he visited most parts of North America and spent some time in South America in the study of cinchona distribution in its native habitat, a subject in which his life-long interest was again manifested in the tercentenary celebration of the discovery of cinchona, which he organized in London in 1930.

Having given full play to the romantic side of his nature in these *Wanderjahre*, Wellcome looked round for a suitable centre for the exercise of his practical bent towards the pharmaceutical side of chemical industry and chose London as his future home, and here in conjunction with the late Mr. S. M. Burroughs he established in 1880 the firm of Messrs. Burroughs, Wellcome and Co. for the manufacture of fine chemicals and pharmaceutical products. The business was a success from the beginning; its products are known all over the world, and in addition to the chief works at Dartford, the firm now carries on operations in New York, Montreal, Sydney, Cape Town, Milan, Shanghai, Bombay and Buenos Ayres and has agencies in most of the world's great commercial centres.

The activities thereby engendered were not enough for Sir Henry Wellcome, and he soon began to use his resources in furtherance of the benevolent and scientific projects he had at heart. He founded at Dartford a club and institute with a park and ground for field sports, and in this and other ways spent large sums in providing technical instruction and means of mental and physical recreation for the staff and work people. In 1894, the Wellcome Physiological Research Laboratories were started, and two years later the Wellcome Chemical Research Laboratories were opened. In 1913 the Wellcome Bureau of Scientific Research was founded with the triple duty of controlling the various research laboratories already in operation, acting as a centre of information on scientific medical matters and to conduct research in biological subjects affecting the progress of medicine. Associated with it are the Entomological Field Laboratories and the Medical Museum, the latter a boon to students and remarkable for the wealth of its pathological material and the ingenuity of its illustrative methods. Sir Henry's latest and most striking gift is the magnificent building of the Wellcome Research Institution, which was described in *NATURE* of December 5, 1931, p. 974, and in which the organizations referred to above, with the exception of the Physiological and the Entomological Field Laboratories, are now housed.

For the greater part of his life, Sir Henry Wellcome had collected books, manuscripts, pictures and materials of all kinds illustrative of the customs and habits of primitive man and the beginnings and progress of pharmacy, medicine and surgery. These formed the nucleus of the Historical Medical Museum organized in 1913 in premises in Wigmore Street, where it rapidly outgrew the accommodation available. Of all his projects for the near future, the one nearest to the founder's heart was probably to see these cherished treasures displayed in the exhibition galleries designed for them in the new building, and it is a matter of keen regret to his friends that he did not live to see the completion of this scheme. Sir Henry's other interests can only be referred to briefly. For some years he conducted personally archaeological explorations in the Upper Nile regions, discovering and excavating several important ancient Ethiopian sites, and since 1932 he has provided funds for the excavations at Tell Duweir (Lachish) of

which an account appeared in *NATURE* of July 18, 1936, p. 135. He gave generously in funds and medical equipment to expeditions for geographical exploration, and his friendship with H. M. Stanley and his deep interest in Africa led among other things to the foundation of the Lady Stanley Maternity Hospital in Uganda, and the establishment in 1900 of Tropical Research Laboratories at the Gordon Memorial College, Khartoum.

In recent years, Sir Henry Wellcome received numerous honours and marks of appreciation of his services to research in medicine and its allied sciences. In 1932 he was elected a fellow of the Royal Society and an honorary fellow of the Royal College of Surgeons. In the same year he was created a knight, and in 1936 he received the Cross of the Officier of the Legion of Honour from the President of the French Republic, and he also had conferred on him, for outstanding services to Spain, the decoration "Comendador de la Orden de la Republica".

By the death of Sir Henry Wellcome, the world loses not only a great, but also an effective giver, for his benefactions were the outcome of a knowledge of the real, but not always obvious, means for the betterment of mankind.

Mr. F. C. Lewis

MR. FRANCIS CHARLES LEWIS was one of five men who unfortunately met their death through an explosion at the Research Department, Woolwich, on July 8. Born at Barry, South Wales, in 1894, he was educated at the Woolwich Polytechnic and Cardiff Municipal Secondary School. He studied at the University College of South Wales and Monmouthshire, Cardiff, graduating B.Sc. (Wales) in 1915. He then joined the staff of Messrs. Nobel's explosives factory at Pembrey, where he later superintended the manufacture of trinitrotoluene. In 1918 he became a member of the Royal Flying Corps, and shortly after the Armistice was appointed technical research chemist by Messrs. British Dyestuffs, Ltd.

In 1921, Mr. Lewis was appointed research chemist on the staff of the Explosives Branch of the Research Department, Woolwich, where his work has been almost entirely concerned with the application of high explosives to the requirements of the fighting services and with improvements in the methods of using these explosives to obtain the highest efficiency. This has included both explosives already in use and new explosives. Research of this type naturally calls for careful precautions in all its stages, and appropriate safeguards are applied to minimize the risks. These precautions have been generally successful, as is shown by the fact that the Explosives Branch has had only one previous fatality due to explosion since it came into existence in 1901.

Mr. Lewis's work has been of great value and his experience of high explosives has greatly assisted in the progress of the work. His loss will be much felt by his colleagues and friends. Mr. Lewis was married in 1920, and leaves a widow and four children.

G. R.

News and Views

Chronology of Early Man and Cultural Associations

IN his recent presidential address to the British Speleological Association (see NATURE of August 1, p. 194) Sir Arthur Keith, when arguing for a parallel evolution in the development of modern races from primitive ancestral forms in their respective continental areas, demonstrated the connexion between the Australian and *Pithecanthropus* of Java, with the aid of mid-Pleistocene Solo man as the connecting link between the early Pleistocene *Pithecanthropus* and the late Pleistocene form of that region, Wadjak man. There would now appear to be a possibility that the chronological position of the undoubtedly archaic form discovered in the gravels of the Solo river at Ngandong, Java, in 1932, may be called in question. In another column of this issue of NATURE (see p. 293) reference is made to a communication from Dr. P. van Stein Callenfels, the distinguished Dutch authority on the archæology of Indonesia, appearing in the current issue of *L'Anthropologie*, in which he points out that the cultural associations of Solo man, harpoons and axes of stag horn, are such as in a European context would denote an antiquity of not more than nine or ten thousand years. While the early dating of Solo man has been generally accepted hitherto, if, as is stated, these artefacts are apparently beyond question contemporary with the human relics, this would appear to demand re-examination of the geological data. If further consideration supports Dr. Callenfels' argument, like the evidence of the Swanscombe skull in relation to the position of Piltdown man (see NATURE, August 1, p. 200), it would suggest that the current phylogenetic scheme, while valid as a logical classification, is an uncertain guide to chronology, and that the evolution and descent of man has been a far more complex process than has been demonstrated hitherto.

Spiritual Healing

AT the Methodist Conference held at Newcastle in July, the report of a Committee on Spiritual Healing was read by the Rev. Leslie D. Weatherhead (*Methodist Recorder*, July 23). He declared it to be an interim report only, and expressed the hope that the Committee would be reappointed. The report is cautious in tone, recognizing that the subject is full of difficulties. The trouble from the scientific point of view is that what appear to be like causes do not necessarily produce like effects. "We pray for one man and he gets better; we pray for another and he does not—and we don't know why in either case." Of course, in healing, the individual factor is the important one, and this makes scientific generalizations almost impossible. The only thing to do, presumably, is to record a large number of cases as accurately as possible, and to extract from them whatever may seem to establish some sort of a regular law of behaviour. Or, as the report puts

it: "the work which lies before students of this subject must include research into those conditions under which those energies which sweep through personality may be set free to do their work." The report wisely says: "We felt all along that a method is not less a manifestation of the Divine because it is understood." As for "orthodox" medical science, "We believe no method [of spiritual healing] is to be welcomed which brushes aside as irrelevant the amazing findings of modern medicine and surgery." It is indeed all to the good that religious bodies such as the Methodist Church should interest themselves in the systematic study of the psychological causes of physical health and sickness, and the report of this Committee is for that reason important.

J. C. Loudon and the Waterloo Beeches

REFERRING to the note in NATURE of August 8 (p. 237) in which this excellent story was mentioned, a correspondent points out that there are many variants of it extant. Sir William Fraser's version, which is by far the most detailed, bears all the signs of study of the original sources. It would spoil the story to condense it; let the worthy baronet tell it in his own inimitable, if stilted, fashion.

"The Duke of Wellington . . . received a letter . . . from the eminent landscape designer and great authority on botanical matters, J. C. Loudon. It was . . . to this effect:

"My lord Duke: It would gratify me extremely if you would permit me to visit Strathfieldsaye, at any time convenient to your Grace, and to inspect the Waterloo beeches. Your Grace's faithful servant, J. C. Loudon."

"The Waterloo beeches were trees that had been planted immediately after the battle of Waterloo; as a memorial of the great fight. The Duke read the letter twice, the writing of which was not very clear; and, with his usual promptness and politeness replied as follows; having read the signature as 'C. J. Loudon' instead of 'J. C. Loudon':

"My dear Bishop of London, It will always give me great pleasure to see you at Strathfieldsaye. Pray come there whenever it suits your convenience, whether I am at home or not. My servant will receive orders to show you so many pairs of breeches of mine as you wish; but why you should wish to inspect those that I wore at the battle of Waterloo is quite beyond the comprehension of Yours most truly, Wellington."

"This letter was received, as may be supposed, with great surprise by the Bishop of London. He showed it to the Archbishop of Canterbury, and to other discreet persons: they came to the melancholy conclusion that the great Duke of Wellington had evidently lost his senses. The Bishop of London (Blomfield) declared that he had

not written to the Duke for two years; and to receive this extraordinary information puzzled the whole Bench of Bishops."

So far Sir William Fraser, whose account may be regarded as authoritative. Fraser (1826-98, Eton, Christ Church, and 1st Life Guards) worshipped the memory of Wellington with a devotion that almost reached fanaticism; his "Words on Wellington", from which this account is taken, is one of the most remarkable collections of sayings and doings that have ever been recorded concerning one individual—remarkable not only in the variety of its Wellingtoniana, but in the insight which it gives into the character of its compiler. The book is long out of print, and has a certain historical value. The author carried out a first-rate piece of detective work, of which he gives a full account, in his identification of the scene of the Duchess of Richmond's famous ball on the eve of the battle of Waterloo.

Scientific and Industrial Research in Australia

THE Australian Government has announced that the work of the Council for Scientific and Industrial Research is to be extended in the interests of secondary industry generally. Since its establishment in 1926, the Council has deliberately restricted its attention to problems of the primary producing industries, though no such restriction is imposed upon it by the Act under which it is constituted. It has always been assumed that an extension was only a matter of time in view of the contraction of world markets for primary products and the consequent pressure to increase the home market by expanding secondary industries. A recent decision to establish aircraft and motor production in the Commonwealth has intensified a growing demand for an extension of national scientific research, and an influential committee, including leading engineers and industrialists, is now at work preparing a definite scheme of work. Existing institutions will be utilized wherever possible, but it is fully recognized by the Government that considerably increased financial obligations must be carried by it. A first step is to establish an agency for the maintenance of accurate fundamental standards of measurement and for the testing of master gauges for controlling precision manufacture. It is intended that in all developments intimate contact shall be maintained with, and guidance sought from, established British institutions engaged on work of the same type.

Luminous Phenomena on the Sea during a Thunderstorm

THE occurrence, during a tropical thunderstorm between Singapore and Bangkok on the morning of May 21, 1936, of a diffused white light over the surface of the sea, pulsating at regular intervals of about two to the second, so that the ship seemed to be sailing through waves of light and darkness, was referred to by a correspondent in *The Times* of June 26. The phenomenon is said to have continued for about half an hour. Another correspondent referred to a similar phenomenon in the Persian Gulf in March

1908, when waves of light were observed wheeling round the ship. Both these phenomena would appear to have been due not to electrical conditions but to phosphorescence. A description and sketch of a "Phosphorescent Wheel" near Sumatra (with an interval of about one second between the waves of light) is given in the *Marine Observer* of the Meteorological Office of November 1926; waves of light with an interval of half a second were observed on October 27, 1924, at 1 a.m. near Krakatoa Island (*Marine Observer*, October 1925); streaks of luminescence, observed in January 1927 in the Equatorial Atlantic, were practically parallel with the wind, which was south-east, about force 4 (*Marine Observer*, January 1928). These observations indicate that phosphorescence is not uniform over the wave profile, and consequently streaks of light will appear to an observer on board ship to move as the ship moves relative to the waves. Phosphorescence is most readily observed on ripples or on the breaking crests of waves, and while no one has yet worked out in detail the conditions under which the streaks will appear, the period of pulsation, which is reported as 0.5-1 second, is probably equal to the interval of time between the passage of the ship over successive waves.

Lightning and Atmospheric

It is now generally agreed that the majority, if not all, the atmospheric encountered in radio communication originate in lightning flashes. When the storm is close to the receiver, it is possible to identify the stronger atmospheric with the neighbouring flashes. In a recent communication, Mr. P. F. Fyson, Langherne House, Rushwick, Worcester, claims to have observed that the atmospheric crackle produced on a broadcasting receiver was heard before the lightning flash which caused it was perceived visually. If this difference in the perception of the two effects is real—it obviously needs verification by other observers—it would appear on first consideration that the human eye is rather more sluggish in its operation than the ear; and Mr. Fyson suggests that this may be due to the time required for the chemical change in the retina to affect the optic nerve. An alternative explanation, however, may be found in the fact, which has arisen from recent research on lightning, that an intermittent electrical discharge appears to precede the actual main lightning flash. It is possible that this discharge may be invisible and yet may be capable of producing audible effects on a wireless receiver. These sounds may thus be heard a very short time before the visible flash was observed.

Champollion and Hieroglyphics

In "Science News a Century Ago", in *NATURE* of August 8 (p. 257), an extract appears from the *Athenæum* describing an obelisk erected to the memory of Champollion, and bearing the inscription "To the memory of F. J. T. Champollion, who first penetrated into the mysteries contained in the writing and monuments of ancient Egypt. . . ." A correspondent has pointed out that, even allowing

for the generosity of interpretation of a 'lapidary inscription', Champollion has no claim to the honour of first penetrating into the mysteries of the writing of ancient Egypt. That honour, beyond all question, belongs to our versatile countryman, Thomas Young. In 1819, Young published an article, "Egypt", in the supplement to the "Encyclopædia Britannica", in which he gave a list of *alphabetic and syllabic characters*, an article which has been described by Sir E. A. Wallis Budge as "practically the foundation of the science of Egyptology". In 1821, two years later, Champollion published a treatise in which he shows not the slightest trace of knowledge of anything alphabetic in hieroglyphic or hieratic characters; Champollion's publication of an alphabet dates from 1822. Concerning Champollion's alleged attempt to suppress his unfortunate work of 1821, we need say nothing here; the whole story of the Rosetta Stone and the decipherment of the hieroglyphic characters was discussed some years ago in an article in *NATURE* (April 30, 1932, p. 638). It is sufficient here to say that the inscription on the tablet to the memory of Young in Westminster Abbey states no more than the bare truth when it describes him as the one who "first penetrated the obscurity which had veiled for ages the Hieroglyphics of Egypt".

Recent Acquisitions at the Science Museum

AMONG the objects recently placed on exhibition in the Science Museum, South Kensington, is a model of the complete lay-out for a 120-ton 10,000 horse-power Mond gas producer plant with ammonia recovery apparatus which has been lent by the Power-Gas Corporation, Ltd. Mr. Edward J. Willis, an American authority on astronomical navigation, has sent from the United States an example of a navigating machine which was invented by him and constructed at a cost of about £300. The machine solves problems in spherical trigonometry connected with navigation. An example of Selling's calculating machine which has long lain neglected in the stores of the Imperial College of Science and Technology has been lent to the Museum for exhibition. The machine was invented fifty years ago and made ingenious use of the 'lazy tongs' mechanism in order to perform multiplication and division. A representative selection of fourteen stone (chert) weights and a plaster cast of a fragment of a linear measure, all found in excavations at Mohenjodaro, Harappa, and elsewhere in northern India—relics of a civilization of c. 3250–2750 B.C., that formed great cities along the Indus valley, contemporaneous with the ancient Egyptian first to fifth dynasties, and the ancient Sumerian kingdoms in Mesopotamia—have been presented by the Archæological Survey of India.

Frontier System in Roman Scotland

A FURTHER effort to settle the question of the number and character of the occupations of the Roman fort of Birrens, near Ecclefechan, Scotland, is being made by excavations now proceeding in charge of Mr. Eric Birley, of the University of Durham.

The problem to be solved is whether the occupation of the fort was part of the organization of the Antonine Vallum, as Sir George Macdonald has suggested, or whether it is to be related to Hadrian's Wall, as the Dere Street forts to the east recently have been shown to be by Mr. Ian Richmond's excavations. Two periods of occupation separated by a destruction were demonstrated in 1925 by excavation, but the examination of the stratification was not, nor was it intended to be, exhaustive. Search for further evidence is now being made, and with this object excavations are proceeding at two points down to the subsoil for a thorough examination of the stratification and the pottery. Up to the present, a section in the *retentura* of the fort, it is reported in *The Times* of August 10, has shown that a wooden building and two of stone preceded the two periods, of which evidence was found in excavations made in 1895. The wooden structure is assigned to the latter part of the first century and it is said that traces of Agricola have been found; while the two stone periods which follow are thought to belong to the Antonine occupation. Under the earlier of the two periods previously known, two vessels have been discovered, for which there are parallels from Hadrian's Wall. A second excavation in the *praetentura* has been more fruitful as a source of pottery and other finds, including a large piece of a cut-glass bowl, of which a fragment was found in 1895. Excavation at the west gate has exposed what is described as "the worst Roman masonry so far found in Scotland".

Archæological Finds in Iraq

DR. HENRI FRANKFORT'S assiduity in making known to the public at an early date any points of special interest arising out of the excavations of which he has been in charge, season by season, is worthy of all commendation, especially since he became field director for the Oriental Institute of the University of Chicago at Tell Asmar, the ancient Eshnunna. The important and extensive operations of the Oriental Institute in the field of the Ancient East possibly are not so widely known, outside the circle of specialists, as they deserve. In his report on the results of the past season (*The Times*, August 1), Dr. Frankfort mentions a number of finds of exceptional interest. As is generally known, one of the objects to which he has given special attention at Tell Asmar and on the neighbouring site of Khafaje is the problem of the early relations of Mesopotamia with both the Indus Valley and the Mediterranean. On both these questions he is able to record new and important evidence, in the former instance pointing to a more intimate relation than the purely commercial connexion, which is all that it has been possible to infer from previous finds. In a temple on a new site, Tell Agrab, the expedition has found among a quantity of interesting material some remarkable examples of stone vases with surprising sculptures. Among these is one fragment which shows the sculptured figure of a humped bull standing before a manger and enclosed in the poles of arches which support a roof. Not only is this a

common motif at Mohenjo-daro, but also it belongs to a cult as alien to Mesopotamia as is the humped bull itself. Its occurrence at Tell Agrab should point to a more than casual or commercial contact. Similarly a further link with the Mediterranean is afforded by a terra cotta relief from a small shrine at Tell Asmar, in which one of the figures, possessing one eye only, and associated with fire, is identified as a cyclops. It is interesting to note how many of the interesting series of finds recorded this year by Dr. Frankfort, such as the bowls which had contained a live snake, are to be referred to cults, popular or otherwise, upon which at present we have no information.

Systematists and Text-Books

IN a recent issue of the *Nederlandsch Tijdschrift voor Geneeskunde* (80, 15, pp. 1675-1677; 1936), Dr. L. D. Brongersma directs attention to the deplorable results which can arise through a lack of understanding of the principles of systematic zoology and zoological nomenclature. As an example of his thesis, Dr. Brongersma surveys the most recent edition of a standard text-book of vertebrate comparative anatomy. The confusion to the student which must arise through different authors using different names for the same animal can scarcely be avoided until the systematists have set their house in order, but there can be no possible excuse for the use of two or more names for the same creature within a single chapter; yet that has happened on numerous occasions. Perhaps even more inexcusable are errors arising from the careless confounding of similar names of very different animals. Dr. Brongersma finds that *Hemidactylus* (a gecko) appears amongst the Urodeles, due to confusion with *Hemidactylum*, and *Neomeris* (intended for a porpoise, but strictly applicable to a polyzoan) is confused with a tortoise and is discussed as a reptile! Further difficulties are due to faulty transcription and proof-reading, which have produced a crop of apparently new names, such as *Chelonia speciosa* written instead of *Chelonia sp.* and *Gecko vertie* intended as an abbreviation of *Gecko verticillatus*. The evils attendant on nomenclatorial changes can certainly be minimized by closer co-operation between teachers of zoology and systematists and by a better understanding of the difficulties which confront the latter in the search for stability. It is consequently gratifying to learn that, as a result of Dr. Brongersma's article, a list of corrigenda will be published in the next volume of the particular work he has criticized, and this will itself be submitted to competent systematists before publication.

A Fire in the Mersey Tunnel

SOME of those who have driven through the three miles long Mersey Tunnel may have thought that it was unnecessary to place fire alarms at distances of fifty yards apart throughout the tunnel and to take the many other special precautions against fire which are described in guide books. Remembering that it cost eight million pounds to build and that 5,000 vehicles per hour use the tunnel, it was necessary

to take every precaution. The first test of the fire alarm installation occurred on July 25, when a lorry carrying cinematograph films from Liverpool to Birkenhead burst into flames inside the tunnel. The driver at once gave the alarm from one of the fire-alarm boxes, and in less than five minutes the Liverpool and Birkenhead fire brigades had put out the fire. An alarm given at any one of the ninety-eight special boxes is received at both the brigade headquarters. At the same time, large neon 'stop' signs on the roof close the tunnel to traffic, and the pay boxes at each entrance are warned by bells and red lights. The 'electromatic' vehicle-actuated traffic signals are automatically interlocked and allow vehicles to leave and prevent them from entering the affected portions of the tunnel. The alarm is also given to the ventilation control room, from which the large electric air fans can be regulated to meet requirements of any situation that may arise.

The Economics of Railway Electrification

THE *Engineer* of July 17, 24 and 31 contains three short articles on main-line electrification abroad, which are devoted to a statistical survey of the financial aspect of electrification. That electric traction has great advantages for suburban traffic and where water-power is plentiful and coal dear is generally admitted, but the fact that only 2½ per cent of the total railway mileage in the world is electrified will, perhaps, come as a surprise to those who advocate the adoption of electrification on a wide scale in Great Britain. Of all European countries, in only one, Switzerland, does electrified mileage predominate, and in only six out of twenty does it exceed trifling proportions. Commenting on this, the *Engineer* says: "It is impossible to believe that this neglect of electrification is due to the supineness and conservatism of so many nations. When it is observed that the German national railway system is only electrified to less than 4 per cent, those who are firmly convinced that there is no more technically progressive nation in the universe will have to admit that the arguments against electrical operation must have been overpowering." Electric traction is undoubtedly an extremely efficient means of transport, but against this has to be put the very high capital costs involved. The arguments against electrification have also been strengthened by the great improvements recently made in steam locomotives and the introduction of Diesel-electric units.

German Road Progress

ALTHOUGH it is only two years since Munich entertained the seventh International Road Congress, the city is holding another road congress and in addition a large exhibition of road building machinery on September 16-27. The Research Department of the German State Highways Commission and the leading road construction firms are in charge of all the arrangements. In *Roads and Road Construction* of August 1, Dr. Otto Reismann outlines the programme for the Congress. He points out that the

present road construction programme in Germany is on so large a scale, and has been pushed forward so rapidly that great improvements in technical matters have ensued in connexion with road and bridge construction. At the Congress these will be discussed by Government, scientific and industrial experts. The road building machinery exhibition will be held in the open on the Munich Fair Ground, and will show the visitors the very rapid progress made in the mechanization of road construction. The quality of the materials used and the design of the machines have been vastly improved. The Congress will not be confined to purely business sessions. The German motor roads are not built merely for transport purposes. An attempt has been made to build them in such a way that they are in harmony with the landscape and the country in which they lie. Included therefore in the Congress programme are excursions and journeys of inspection over specially constructed motor roads and over the German Alpine highways. At the same time as the Congress there will be an art exhibition on roads as seen by modern art. This is an attempt to demonstrate the strong impression modern art has received from the inspiration of the new roads. It is anticipated that the first 600 miles of the new motor roads (*autobahn*) will be thrown open to traffic in the coming autumn. In two years time, thoroughfares will be completed between Hamburg and Karlsruhe, Stettin and Munich, Ruhr and Karlsruhe, and Stuttgart to Salzburg via Munich.

Crops and Livestock in England and Wales

THE Ministry of Agriculture and Fisheries has recently issued the first part of its publication, "Agricultural Statistics, 1934", entitled "Acreage and Production of Crops and Number of Livestock in England and Wales" (London: H.M. Stationery Office, 1s. 6d. net), a report which summarizes the annual returns from all holdings exceeding one acre. An outstanding feature is the arrest of the continuous change from arable to grass that has been going on since the Great War, the area under permanent grass showing a reduction on the previous year, whereas the total area under corn has expanded during the same period. As regards roots, the acreage under sugar beet reached a new record figure; that under fodder roots and potatoes, on the other hand, showed a decline. Yields were generally high, being above the average for all corn crops, potatoes, mangolds, hops and several kinds of fruit, though appreciably below normal for hay, turnips and swedes. The numbers of cattle, dairy cows, pigs and poultry have risen since 1933, whereas those for sheep and horses have declined, and as might be expected the output of meat and livestock products, eggs and milk have all shown considerable increases, while the wool clip was substantially reduced. An interesting feature of the report lies in the attainment of many record figures, the yield of wheat and apples being attributable no doubt to the favourable season, and the output of dairy and poultry products to the increase in numbers of cows and birds maintained. Records in

area, total production and yield per acre were also reached in the case of sugar beet, while the area under oats, turnips and swedes fell to the lowest figure yet attained, reflecting the changes that are taking place in farming practice.

Mining and Fuel Research at Sheffield

WE have received from the University of Sheffield a report on the research work done in the Departments of Mining and Fuel Technology during the year 1934-35. The former includes numerous subjects, such as mine ventilation, mine lighting, research on trailing cables, accuracy of mine surveys (in which we miss, however, any reference to the very valuable work done by the Institution of Mine Surveyors), subsidence resulting from mining operations, gas testing, movement of firedamp, fireproofing of mine timber, whilst in the Department of Fuel Technology the composition and decomposition and analysis of coal have been carefully studied. The formation of coke, the combustion of coke and the testing of coke have also received attention. A perusal of this pamphlet cannot fail to be of interest to colliery managers.

Symbols for Heat and Thermodynamics

AN attempt will be made to relieve the present chaotic situation with regard to symbols for equations in thermodynamics at an international conference which has been called by the American Society of Mechanical Engineers, to be held in New York on September 14-15, 1936. The Conference has been arranged for this time so that some of the delegates to the World Power Conference to be held the week previous in Washington, D.C., may also act as representatives at the Symbols Conference. American usage in regard to such symbols has become fairly well standardized; but other lists have been issued by various European bodies. The Conference will endeavour to compromise the differences in the several lists.

Fifty Years of West Ham

THE jubilee of the incorporation of the borough of West Ham has been the occasion for the publication of a volume illustrated by maps, photographs and old prints on the history and past and present activities of the borough ("Fifty Years a Borough". Edited by D. McDougall. West Ham County Borough Council 1936). The chief scientific interest in this municipal enterprise is the full account of the growth of the borough from Anglo-Saxon times and its relationship to the Lea and other rivers which were important influences in deciding direction of growth. The chapters on the local government and social services are also of considerable interest.

Sterilization Operations in the United States

ACCORDING to a Science Service bulletin, steady increase in sterilization operations performed on insane and feeble-minded patients in the United States is reported by the Human Betterment Foundation, Pasadena. A total of 23,092 such operations

had been officially performed up to January 1, 1936. This does not include operations of this nature privately performed, but is limited to those performed under State laws in the institutions of the twenty-eight States now having sterilization laws in force.

Announcements

PROF. J. BASIL BUXTON, professor of animal pathology in the University of Cambridge, and director of the Institute of Animal Pathology and of the University Field Laboratories, Cambridge, has been appointed acting principal and acting dean of the Royal Veterinary College from September 25, and to succeed Sir Frederick Hobday as principal and dean on the retirement of Sir Frederick after the opening of the main block of the new college buildings.

At a recent meeting of the North East Coast Institution of Engineers and Shipbuilders the following awards were made: *Institution Gold Medals* (Engineering), to Eng. Comdr. C. J. Hawkes and G. F. Hardy, for a paper entitled "Friction of Piston Rings"; (Shipbuilding), to R. C. Thompson, for a paper entitled "Modernizing the Motor Vessels 'Silverpine' and 'Silverlarch' and Increasing Their Service Speed"; *M. C. James Medal*, to W. C. S. Wigley, for a paper entitled, "The Theory of the Bulbous Bow and Its Practical Application"; *Institution Scholarship*, to Anthony Gilchrist; *Thomas Fenwick Reed Medal*, to Dr. Will Pratt.

THE second International Congress of the International Association for Testing Materials will be held in London on April 19-24, 1937, under the presidency of Sir William Bragg. The Congress will be open to anyone on payment of membership fee. The subjects selected for discussion will be classed into the following groups: A, Metals; B, Inorganic Materials; C, Organic Materials; D, Subjects of General Importance. Further information can be obtained from the honorary secretary, Mr. K. Headlam-Morley, 28 Victoria Street, London, S.W.1.

DR. MAX BODENSTEIN, professor of physical chemistry at Berlin, has been awarded the Bunsen Medal by the German Bunsen Society for applied physical chemistry, and Dr. Max Le Blanc, professor of physical chemistry at Leipzig, has been elected an honorary member of the Society.

DR. DONALD D. VAN SLYKE, a member of the Rockefeller Institute of Medical Research, has been awarded the Charles Mickle fellowship of the University of Toronto for his work on blood analysis, respiratory and renal reactions, diabetes and nephritis.

A MINISTRY of Health has recently been formed in Belgium under the direction of M. Emil Vandervelde, the well-known Socialist leader.

THE twenty-fifth Congress of the German Physiological Society will be held at Giessen and Bad Nauheim on August 30-September 2 in conjunction

with the German Pharmacological Society. Further information can be obtained from Prof. Dr. Burkner, Physiologisches Institut, Giessen.

THE twenty-third French Congress of Hygiene will be held at the Institut Pasteur, Paris, on October 20-22, under the presidency of Prof. Leclainche. Further information can be obtained from the general secretary, Dr. R. Dujarric de la Rivière, Institut Pasteur, 28 rue du Docteur Roux, Paris, 15^e.

FOUR committees (medical, engineering, economic and legal, and administrative) have been appointed in the United States, consisting of health experts, representatives of employers, workers, insurance companies, Government, technical societies and engineers, to attempt to devise a method for putting an end to silicosis.

EIGHTY-SIX cities in the United States with an estimated population of 37 millions reported 8,799 deaths from motor accidents in 1935 as compared with 9,060 deaths in 1934. Forty-eight of the cities showed a decrease in the total number of fatalities; thirty-six showed increases and two cities reported the same number of deaths in 1935 as in 1934.

THE fifteenth Annual Clinical and Scientific Session of the American Congress of Physical Therapy will be held at the Waldorf-Astoria Hotel, New York, on September 7-11. The programme will include symposia on short-wave diathermy, hydrotherapy, exercise, electro-resection, fever therapy, treatment of vascular diseases, the educational aspects of physical therapy, the relationship of physical technicians to physicians and hospital departments, and technical and scientific exhibits. Further information can be obtained from Dr. Norman E. Titus, 730 Fifth Avenue, New York.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Two assistant experimental officers (Grade D) (physics or engineering) in a War Department at Woolwich—The Superintendent, Experimental Signals Establishment, Woolwich Common, S.E.18 (August 18).

A scientific officer (physics or engineering) in a Government establishment of the War Department—The Secretary, Royal Engineer Board, Regent's Park Barracks, Albany Street, N.W.1 (August 26).

A chemist in the Department of War Department Chemist—The Under-Secretary of State (C.5), War Office, S.W.1 (September 7).

An assistant keeper in the Science Museum, South Kensington, S.W.7—The Director (September 7).

An Elder professor of anatomy and histology in the University of Adelaide—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, W.C.1 (September 20).

A temporary lecturer in zoology in the University of Cape Town—Prof. T. A. Stephenson (October 5).

A lecturer in civil engineering and building in the Portsmouth Municipal College—The Registrar.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 292.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Some Observations on the C Regions of the Ionosphere

RECENT observations at Calcutta^{1,2}, at Morgantown (U.S.A.)³ and Orfordness (England)⁴ have established beyond doubt the existence of ionized layers much below the Kennelly-Heaviside *E* layer. Not infrequently these layers act as good reflectors of radio waves. The topmost of these layers (sometimes called the *D* layer) is situated at an average equivalent height of 55 km. The next one lies between 20 km. and 35 km., and the lowest ones appear to be situated within the tropospheric region between heights of 5 km. and 15 km. (It has recently been suggested by Mitra⁵ that since the designation *D* is usually applied to the non-deviating absorbing 'tail' of the *E* region, the new regions be called *C* regions. It would perhaps be convenient to call them, starting from the top, *C*₁, *C*₂, and *C*₃ regions.)

Since data regarding the properties of these regions—particularly of the lower ones—are still lacking, we have recently carried out a series of 24-hour observations, at intervals of one hour and a half, using a frequency range of 1–15 mc./sec. The results of our observations are summarized below.

(1) Echoes from *C*₁ (55 km.) are much more frequent and are of greater strength than those from *C*₂ and *C*₃. *C*₂-echoes (25–30 km.) are also strong and are more frequent than *C*₃-echoes; the latter are weak and are observed on rare occasions. *C*₁, *E*- and *F*-echoes of moderate strength have been observed on several occasions to occur side by side.

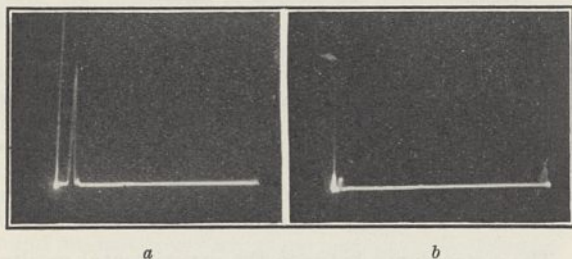


FIG. 1. Echoes from: (a), *C*₁ region (55 km.); (b), *C*₂ region (20 km.).

(2) Echoes recorded during day-time are invariably weaker than those recorded during the night. The intensities of *C*₁- and *C*₂-echoes have occasionally been found at night to be comparable with those of fairly strong *E*- and *F*-echoes.

Fig. 1a shows a *C*₁-echo (55 km.) with 3 mc./sec. frequency as received at midnight of June 5. Fig. 1b shows a *C*₂-echo (20 km.) with a frequency of 2.18 mc./sec. recorded at 1900 hours on June 12. A closer examination will reveal the presence in Fig. 1b of another very low height echo (8 km.) and traces of single and double reflections from the *E* region.

(3) Echoes have been observed at all times of the day and night; but they seem to be more frequent during the afternoon and are usually too weak to be detected at about midday.

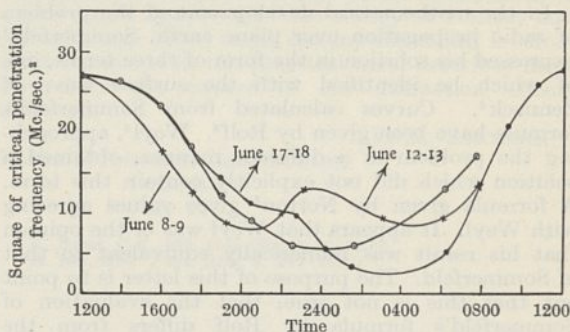


FIG. 2. Hourly variation of the square of the critical penetration frequency (noon to noon) of the *C*₁ region (55 km.) on three typical days.

(4) Curves in Fig. 2 represent hourly variation of the square of the penetration frequency (f^2) for the *C*₁ region for three selected days and are typical of those usually obtained in the course of our observations. It is evident that the ionization in general attains its daily maximum at about noon, and tends to a minimum during the small hours of the morning. There are also at times abnormal variations which appear to be more pronounced at night. The general nature of the hourly variation, however, leads one to conclude that the ionization is of solar origin.

(5) The critical penetration frequencies of the *C*₂ and *C*₃ regions have been obtained occasionally. But the occurrence of these echoes, particularly those from *C*₃, is not frequent enough to enable one to study the hourly variation of ionization of the corresponding regions. It may, however, be mentioned that the average values of the penetration frequencies are of the same order as those for the *C*₁ region.

The observations described here were carried out at the suggestion of Prof. S. K. Mitra.

Wireless Laboratory,
University College of Science,
Calcutta.
June 22.

H. RAKSHIT.
J. N. BHAR.

¹ S. K. Mitra and P. Syam, *NATURE*, **135**, 953 (1935).

² S. K. Mitra and J. N. Bhar, *Science and Culture*, **1**, 782 (1936).

³ R. C. Colwell and A. W. Friend, *NATURE*, **137**, 782 (1936).

⁴ R. A. Watson Watt, L. H. Bainbridge Bell, A. F. Wilkins and E. G. Bowen, *NATURE*, **137**, 866 (1936).

⁵ S. K. Mitra, *NATURE*, **137**, 867 (1936).

IN connexion with the above observations of Dr. Rakshit and Mr. Bhar on the *C* regions, I would like to point out that it is not justifiable to take the hourly variation of f^2 as proportional to the variation

of the ionization density (N) in these low regions of the ionosphere. The collisional frequency (ν) is high at such levels, and in the C_1 region it is perhaps comparable with $2\pi f$. Conditions favourable for reflection (or penetration) may be brought about either by an increase (or decrease) of N or by a decrease (or increase) of ν . It is quite conceivable that the atmospheric density and, along with it, ν , varies from hour to hour at such levels, and the abnormalities observed in Fig. 2 may have been caused either by a variation of N or by a variation of ν or by both occurring simultaneously.

S. K. MITRA.

London.
July 5.

Existence of a Surface Wave in Radio Propagation

IN the mathematical development of the problem of radio propagation over plane earth, Sommerfeld¹ expressed his solution in the form of three terms, one of which he identified with the surface wave of Zenneck². Curves calculated from Sommerfeld's formula have been given by Rolf³. Weyl⁴, approaching the problem in a different manner, obtained a solution which did not explicitly contain this term. A formula given by Norton⁵ gives values agreeing with Weyl. It appears that Weyl was of the opinion that his result was numerically equivalent to that of Sommerfeld. The purpose of this letter is to point out that this is not true, that the evaluation of Sommerfeld's formula by Rolf differs from the formulae of Weyl and Norton by exactly the 'surface wave' component, and to give the results of a recent experiment showing the Weyl-Norton values to be the correct ones, which raises a question as to whether surface waves do or do not physically exist.

Previously available experimental data that might be used to decide which expression is correct have, unfortunately, been obtained under conditions for which Sommerfeld and Weyl do not differ greatly. For ultra-short wave propagation over deep fresh-water, however, their results differ enormously. To make a test under these crucial conditions, an experiment on the propagation of 2-metre waves has been conducted over Seneca Lake, New York State. The variation of the field with distance was found to agree well with Weyl. At a distance of about 1.8 km., where Sommerfeld's formula gives values about 1,000 times that of Weyl, the field was studied as a function of antenna height and polarization. Whereas Sommerfeld's expression for the surface wave gives values decreasing with height, the measured field actually increased. At the greater heights, the field was independent of polarization, as it should be if there were no surface wave. Since there is no uncertainty in the correct formula to use for horizontal polarization, this comparison showed that the field at the earth's surface was about 0.001 of the value predicted by Sommerfeld. It seems evident that a revision of the Sommerfeld-Rolf curves is required for propagation over all types of ground for which the dielectric constant cannot be neglected.

CHAS. R. BURROWS.

Bell Telephone Laboratories, Inc.,
Deal, New Jersey.
July 14.

¹ A. Sommerfeld, *Ann. Phys.*, **4**, 28, 665 (1909); *Jahrb. drahtl. u. t.*, **4**, 157 (1911).

² J. Zenneck, *Ann. Phys.*, **4**, 23, 846 (1907).

³ B. Rolf, *Proc. Inst. Rad. Eng.*, **18**, 391 (1931).

⁴ H. Weyl, *Ann. Phys.*, **4**, 60, 481 (1919).

⁵ K. A. Norton, *NATURE*, **135**, 954 (1935).

Specific Ionization of Cosmic Radiation

AFTER Danforth and Ramsay's recent publication¹ I think it would be of interest to give here briefly the results of similar work, carried out last year, the conclusions of which have been proposed as a thesis at the University of Brussels (April 29, 1936) but cannot be published *in extenso* in a periodical before December next.

The problem is to measure the specific ionization of a penetrating radiation (cosmic radiation, fast electrons, etc.) by the comparison of the efficiency of a Geiger-Müller counter (single impulse or coincidence) corresponding to different internal pressures.

This method was indicated by Tuwim² in 1931, and by us³ in 1933. The integration necessary for the determination of the mean length of the internal path was resolved by Tuwim and Kolhörster⁴ (1933) in a particular case; unfortunately, that case was not very convenient for the precise determination of specific ionization.

I have solved that integration graphically and numerically with sufficient approximation (error less than one per cent) in the general case of two identical counters, parallel, connected for counting coincidences.

This calculation shows that the approximate formula used by Danforth and Ramsay, and by me in 1933, was definitely different from the true one (more than five per cent discrepancy). I had also shown experimentally that a single pair of ions gives a discharge of the counter with a probability of 0.999; the corrections due to showers, accidental coincidences, recovery time, latent time, barometric effect, etc., have been discussed and taken into account.

The counters used had an over-voltage range of the order of 1,000 volts, a reproducibility better than 0.5 per cent during many months, and a residual frequency of impulses that may be neglected.

The following results were found: Total cosmic radiation:

Specific primary ionization:

Hydrogen	5.96 ± 0.07 cm. ⁻¹ (0°-760 mm.)
Helium	5.96 ± 0.15 "
Argon	29.40 ± 2.0 "

Specific total ionization:

Argon	71.40 ± 2.0 "
-------	---------------

Absolute intensity of cosmic radiation (number of rays crossing per second a sphere of 1 cm.² of cross-section):

Brussels (reduced to sea-level) (760 mm.):

$$0.0266 \pm 0.0003 \text{ cm.}^{-2} \text{ sec.}^{-1}.$$

The concordance between the experimental results and the calculated curve (mean error, 0.9 per cent, equal to the calculated most probable error due to uncertainty of readings) indicates a remarkable homogeneity of specific ionization of the different components of cosmic radiation (primary and secondary).

MAX G. E. COSYNS.

Physical Laboratory,
"Fondation Médicale Reine Elisabeth",
Brussels. July 21.

¹ *Phys. Rev.*, **49**, 854 (June 1936).

² *Berl. Ber.*, 830 (1931).

³ Cosyns et de Bruyn, *Bull. Ac. Belg.*, **20**, 371 (1934).

⁴ Tuwim und Kolhörster, *Z. Phys.*, **73**, 130 (1931).

Diffraction of Light by Ultra-Sonic Waves

In a recent paper, R. Lucas¹ has described an experiment designed to test the relative merits of a theory, proposed by C. V. Raman and N. S. Nagendra Nath, of the scattering of light by high-frequency sound waves and that due to himself and P. Biquard. The two theories differ in that, while Raman and Nath assume only a change in phase of normally incident light as it progresses through the sound field, Lucas and Biquard's theory takes account of changes in both amplitude and phase. Lucas's experiment appears to prove by indirect methods that the theory of Raman and Nath is true only for sound fields of thicknesses of the order of 4 mm. or less. R. Bär² has also reported on an experiment which indicates that while the Raman-Nath theory predicts a type of intensity distribution which agrees qualitatively with the observed patterns at frequencies of 1.5 and 7.5 megacycles, there are several discrepancies which indicate that the fundamental assumption of these authors is incorrect. The portion of their theory dealing with oblique incidence apparently gives results which are not in accord with the observations, particularly at the higher frequency. Furthermore, Bär has obtained 'photographs' of the actual ultra-sonic grating by the insertion of a photographic plate in an appropriate position in the light beam behind the stationary sound field. With no lens system of any type to focus the light rays, a series of quite sharp fringes appears on the plate, indicating the presence of some changes in light amplitude as well as in phase.

I have recently completed some experiments, which are to be published shortly in the *Canadian Journal of Research*, in which the distribution of light energy among the various diffraction orders has been measured as a function of ultra-sonic intensity at a number of frequencies in the region of 5 megacycles per second. Using light of wave-length 589 m μ , path lengths of about 2.5 cm. and ultra-sonic intensities ranging from zero to about 0.2 watts per cm.², it is found that the envelopes of the diffraction patterns as predicted by the Raman-Nath theory are in excellent agreement with the observations for light scattered in both progressive and standing wave fields, the intensities of positive and negative orders from zero to five being measured.

In view of this close agreement, it appears somewhat strange that further experimental evidence should indicate the fundamental assumption of Raman and Nath to be in error. The explanation may possibly be found in the deviations of a practical sound field from the ideal case postulated by these authors, who for simplicity assume the sound field to consist of a rectangular prism of plane waves, the sound intensity over any plane normal to the direction of motion of the waves being constant at any instant. A light ray incident normally on such a field would suffer retardations in phase only. In the practical case, however, the sound field does not fulfil these conditions, particularly at the edges. It is probable that a light ray incident in a direction normal to the axis of the field may suffer some refraction on entering the sound field. Once bent, the ray will be traversing layers of varying refractive index and will suffer some changes in amplitude. Eventually, the various rays may come to a series of foci, thus producing the fringes observed by Bär. In such a field the Raman-Nath theory for oblique incidence might also fail, as noted by Bär.

The fact that the discrepancies between theory and observation are less at the lower frequencies tends to support the above hypothesis since, as the sound wave-length is increased, the probability of a light ray entering the field under the conditions postulated by Raman and Nath is considerably greater. In the case of normal incidence, it is quite conceivable that small changes in amplitude, coupled with the normal changes in phase, give rise to an emergent light wave surface which approximates very closely to that which would be produced if changes in phase alone had occurred. That this is the case appears to be substantiated by the very close agreement between the predicted intensities in the various orders and those measured quantitatively by me and observed qualitatively by Bär.

Until a theory is developed which takes complete account of the nature of a practical sound field, it would hence appear that the theory of Raman and Nath, though based on an assumption which is somewhat erroneous in the practical case, describes most accurately the nature of the diffraction effects observed.

F. H. SANDERS.

National Research Laboratories,

Ottawa.

July 11.

¹ R. Lucas, *C.R.*, **202**, 1165 (March 30, 1936).

² R. Bär, *Helv. Phys. Acta*, **9**, 265 (1936).

Absorption Spectrum of Heavy Methane (CH₃D) in the Photographic Infra-Red

WE have recently prepared 40 litres of mono-deuteromethane and examined its absorption spectrum in the photographic infra-red from 12,000 Å. to 6000 Å. under the high dispersion of a grating spectrograph. Examination of our plates reveals complete absence of even the strongest lines of ordinary methane; absence of the heavier methanes was shown by density determinations carried out on a specially fractionated sample.

The spectrum includes a region of intense absorption extending from 8350 cm.⁻¹ to 9000 cm.⁻¹ with a particularly strong and broad maximum at 8617 cm.⁻¹. The structure here is complex, but if anything simpler than with ordinary methane, although no obvious regularities stand out. Of particular interest is the occurrence at 9065 cm.⁻¹ of a band with a simple structure of regularly spaced lines (approximate spacing 7.5 cm.⁻¹) and with what may be a Q branch at 9021 cm.⁻¹. In the case of methane¹, a similar band is found at 9047 cm.⁻¹ with a spacing of 10.5 cm.⁻¹, and apparently similar bands are also shown by methyl halides² round about 9025 cm.⁻¹. The region from 9600 cm.⁻¹ to 10,200 cm.⁻¹ is occupied by some ten fainter bands. Then from 10,960 cm.⁻¹ to 11,220 cm.⁻¹ come four bands, that at 11,220 cm.⁻¹ being relatively strong and very similar in appearance to the methane band of the same frequency.

A detailed discussion of this spectrum will shortly be published elsewhere.

W. H. J. CHILDS.

H. A. JAHN.

Davy Faraday Laboratory,

Royal Institution,

London, W.1.

July 22.

¹ W. H. J. Childs, *Proc. Roy. Soc., A*, **153**, 555 (1936).

² H. Verleger, *Z. Phys.*, **98**, 342 (1936).

The Cepheid Variables and Black-Body Radiation

IN dealing with the problem of determining the concurrent variations in radius and temperature in the Cepheid variables, in order, for example, to construct the Milne diagram¹ for the variability, two possible alternative points of view may be considered, each being inconsistent with the other.

(1) The radial velocities, determined from the displacement of the absorption lines in the spectrum, can be taken to represent unchanged the radial motion of the photosphere. In this case the pulsation theory in its present form has to be abandoned, and it is further necessary to assume that the Cepheid radiation deviates very markedly from that of a black body. These are the postulates favoured by Getting², who has in this way prepared Milne diagrams for a number of Cepheids.

(2) We may assume the radiation to approximate closely to that of a black body, and consider the radial velocities to give a measure of the motion of the atmospheric layers only. The radius of the photosphere at any phase must then be considered as completely unknown; the temperature and radius can, however, be determined by the application of the Planck radiation formula, from magnitude determinations in light of two different wave-lengths.

At the present stage of our knowledge, it appears doubtful, however, whether we can assume, a priori, that the velocity of the atmospheric layers reflects the motion of the photosphere. It is known that the radial velocity curve differs for lines at different levels in the atmosphere, both with regard to phase and to amplitude. It is difficult to decide which level is to be taken as representing the motion of the photosphere.

Further, we are at present unable to give a satisfactory picture of the chromosphere in a static star. It follows therefore that the problem of the pulsations of an extended atmosphere in which the photospheric temperature and surface gravity are both undergoing considerable variations is very far from solution; in fact, until some attempt has been made to predict the behaviour of such an atmosphere, it appears advisable not to use the radial velocities to determine the motion of the stellar body.

If (1) fails, we are forced to investigate the possibility that the Cepheids radiate as black bodies. A recent investigation by Kox³, with this object, has led to the conclusion that this is definitely not the case. Kox has, however, made the initial assumption that the radial velocities give the stellar motion, which is inconsistent with the possibility of black-body radiation, so that his conclusion is not unexpected, and must be regarded as invalid. If, in conformity with (2) above, we assume the radius at any phase to be completely unknown, Kox's observations of the amplitude of light variation in two regions of different wave-length enable us to calculate maximum and minimum temperatures and radii, but are incapable of providing a test of the agreement of the stellar radiation with that demanded by the Planck formula.

It is obvious, however, that if the amplitude of light variation could be determined in three or more wave-lengths, the maximum and minimum temperatures and radii could be calculated from the results of any two such determinations. If the Planck formula is satisfied, the remaining observations should all be consistent with these results.

Kox gives material for δ Cephei from other investigations which enable us to test this conclusion. It

is found that if all observed amplitudes are corrected by the same term, depending on the maximum and minimum radii, determined from two observations, the temperature range ΔT required to produce the corrected variation in light is 1,810°. The probable error of a single ΔT is 30°, which would be produced by an error of approximately 0.015 mag. in the observed amplitude, and can, therefore, be explained entirely by errors of observation.

On the present data, the conclusion therefore is that the light variation in the Cepheids is consistent with the joint assumptions:

(a) The stars radiate to a close approximation as black bodies.

(b) The photospheric radius is considerably greater at minimum light than at maximum, that is, the radial velocities are not to be regarded as reflecting unchanged the motion of the photosphere.

A. E. H. BLEKSLEY.

University of Witwatersrand,
Johannesburg.
June 26.

¹ E. A. Milne, *Mon. Not. Roy. Ast. Soc.*, **94**, 418 (1934).

² Getting, *ibid.*, **95**, 139 (1934).

³ Kox, *Astr. Nach.*, **256**, 21 (1935).

Thermal Conductivity of Deuterium

IN the course of an experimental investigation of thermal conduction in deuterium-hydrogen mixtures, recently completed, determinations of the absolute value of the thermal conductivity of deuterium have been made. The method used in these determinations was the hot wire method as developed by Gregory and Archer^{1,2}.

The deuterium was prepared from deuterium oxide of guaranteed 99.95 per cent concentration, supplied by Imperial Chemical Industries, Ltd., and two independent methods of preparation were adopted:

(1) The vapour of the deuterium oxide was passed over pure magnesium, heated by means of an electric furnace to about 500° C. in a quartz tube, after very careful and prolonged de-gassing of the magnesium. In this instance, the value of the thermal conductivity of deuterium at 0° C. obtained from the measurements was

$$0.000308_2 \text{ cal. cm.}^{-1} \text{ sec.}^{-1} \text{ deg.}^{-1} \text{ C.}$$

(2) The deuterium was prepared by decomposition of the oxide by metallic sodium, the sodium having been previously boiled *in vacuo* to remove all traces of air and other impurities. In this case, the value of the thermal conductivity of deuterium at 0° C. found was

$$0.000307_8 \text{ cal. cm.}^{-1} \text{ sec.}^{-1} \text{ deg.}^{-1} \text{ C.}$$

In both cases, the observations were checked by repetition of the preparations, using different samples of the deuterium oxide. Also, the same apparatus was used to determine the thermal conductivity of pure hydrogen, prepared by the magnesium method from pure water. The value at 0° C. was found to be

$$0.000418_2 \text{ cal. cm.}^{-1} \text{ sec.}^{-1} \text{ deg.}^{-1} \text{ C.}$$

The accuracy of all the results is estimated to be of the order of 0.25 per cent.

It is of interest to note that the value for deuterium obtained by calculation³ from the experimental value for hydrogen is

$$0.000295_5 \text{ cal. cm.}^{-1} \text{ sec.}^{-1} \text{ deg.}^{-1} \text{ C.}$$

while the actual measurements of Kannuluik⁴ gave 0.000329_4 cal. cm.⁻¹ sec.⁻¹ deg.⁻¹ C.

A detailed account of the investigations will be published elsewhere in the near future.

CHARLES T. ARCHER.

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

July 22.

¹ Gregory and Archer, *Proc. Roy. Soc., A*, **110**, 91 (1926).

² Gregory and Archer, *Phil. Mag.* (7), **15**, 301 (1933).

³ "Ortho-, Para- and Heavy Hydrogen", Farkas A., p. 148.

⁴ Kannuluik, *NATURE*, **137**, 741 (1936).

Effects of Hypertonic Media on the Contractile Vacuoles of Protozoa

It has long been suspected that the contractile vacuoles of Protozoa maintain the internal osmotic pressure of the organism above that of the external medium, and it has been argued that, if this is correct, the rate of vacuolar output should be reduced when the external osmotic pressure is raised. This has been found to be true for various Ciliata, and recent work has made it necessary to examine evidence of this nature more critically.

In *Peritrich Ciliates*¹ and in *Paramecium*², it has been found that if the external osmotic pressure is raised sufficiently the body shrinks, but that the contractile vacuole may continue to eject water, although at a reduced rate, even after this shrinkage. Kamada² has argued from his results with *Paramecium* that since the body has shrunk, the internal osmotic pressure is no longer above the external osmotic pressure, and hence that no more water can be entering through the body surface, and therefore in turn that the water ejected by the contractile vacuole must be of internal and metabolic origin. This argument is open to criticism.

According to the osmotic control theory, the contractile vacuole acts as a pump which, by utilizing energy, ejects water and retains the salts of the organism. There is no reason whatsoever why the contractile vacuole should stop as soon as the external osmotic pressure is raised so as to equal or exceed the (original) internal osmotic pressure of the organism. Its continuance would lead to a raising of the internal osmotic pressure by a shrinkage of the body until a new and steady value was attained above that of the new external medium. One might, however, expect a decrease in rate of output owing to the increased energy required to separate water from a more concentrated internal solution. Only if the external osmotic pressure were raised very considerably above the original internal osmotic pressure of the organism would one necessarily expect the contractile vacuole to stop completely.

After an increase in the osmotic pressure of the external medium, in the process of reaching a new steady state (1) the body will shrink, and the internal osmotic pressure will therefore be raised, with the result that (2) the rate of vacuolar output will (probably) decrease, and (3) the rate of entry of water by osmosis through the body surface will increase (even from zero or from a negative value). The body volume will become constant when it has decreased to such a value that the rates of loss (2) and gain (3) of water are equal. There is no reason for expecting a linear relationship between rate of vacuolar output and external osmotic pressure. The rate of vacuolar output will be dependent on unknown

internal factors such as the water content or salt concentration of the tissues. This theory is in good accordance with the data which are available for Ciliata.

The situation is more complicated for *Amœba*, and the evidence is more conflicting, although a similar explanation may be applicable. Adolph³ found that the contractile vacuole of *Amœba proteus* maintained its rate of output undiminished when the organism was subjected to pure solutions of sodium chloride or other salts up to $M/20$ in concentration (that is, of osmotic pressure equal to about one-tenth of that of sea water). But Zuelzer⁴ found that fresh-water amœbæ lost their contractile vacuoles when transferred to sea water, and Hogue⁵ found that marine amœbæ developed contractile vacuoles when cultured on an agar medium made up with fresh-water.

It seems therefore probable that Adolph did not use strong enough solutions, and in any event pure sodium chloride is scarcely a suitable medium for the purpose. It may be stated in conclusion that the situation as regards amœbæ is still unsettled, but that the evidence so far available is not inconsistent with the osmotic control theory of the contractile vacuole.

J. A. KITCHING.

Birkbeck College,
London.

¹ Kitching, J. A., *J. Exp. Biol.*, **11**, 364 (1934).

² Kamada, T., *J. Sci. Tokyo Imp. Univ.*, **4**, 49 (1935).

³ Adolph, E. F., *J. Exp. Zool.*, **44**, 355 (1926).

⁴ Zuelzer, M., *Archiv Entw. Mech.*, **29**, 632 (1910).

⁵ Hogue, M. J., *J. Elisha Mitchell Sci. Soc.*, **39**, 49 (1923).

Colloid Osmotic Pressure of the Body Fluids of Freshwater Animals

THE fact that the colloid osmotic pressures exerted by the body fluids of marine animals arrange themselves in the order of their phylogenetic development¹, suggested that there exists a definite relationship between the general organization of an animal and the colloid osmotic pressure of its body fluids. The results of the measurements undertaken with the hæmolymphs of some terrestrial invertebrates confirmed this hypothesis; the values obtained² were indeed practically the same as those of the body fluids of the corresponding marine animals. I concluded from these observations that neither sea water nor air as surrounding media have any marked influence on the above-mentioned relation.

It was interesting to see whether this relationship is modified by life in fresh-water. I have therefore measured the colloid osmotic pressures of the body fluids of some freshwater animals and compared the results with the data previously found for the corresponding marine groups. The animals used were one species of lamellibranch Molluscs (*Anodonta cellensis*), two species of gasteropod Molluscs (*Limnæa stagnalis*, *L. auricularis*), one decapod Crustacean (*Astacus fluviatilis*), and three teleostean fishes³ (*Cyprinus carpio*, *Esox lussius*, *Anguilla vulgaris*). The following table gives the average values of each of these groups (except the values obtained with the serum of the eel, which will be discussed below) and, for comparison, the average values of the corresponding marine animals :

	Marine animals (cm. H ₂ O)	Freshwater animals (cm. H ₂ O)
Lamellibranch molluscs	1.1	0.8
Gasteropod molluscs	1.5	1.2
Decapod crustaceans	3.6	3.1
Teleostean fishes	19.0	11.9

The table shows that the colloid osmotic pressures of the body fluids of freshwater animals arrange themselves, as well as those of the marine animals, in the order of phylogenetic development. The parallelism between the two series of figures is striking. There is, however, a marked difference between the marine animals and those living in fresh-water: the values for the freshwater animals are 20-35 per cent lower than those given by the body fluids of the marine animals. This difference does not conflict with the hypothesis of a relation between the general organization of an animal and the colloid osmotic pressure of its body fluids, but even strengthens it. The freshwater fauna being considered as a regressive branch of the aquatic fauna in general, this regression expresses itself by a diminution of the colloid osmotic pressure of the body fluids of these animals.

There is one exception from this rule: the eel's serum exerts a colloid osmotic pressure varying from 19.9 to 27.2 cm. H₂O. This exception, however, does not in the least weaken the hypothesis; though passing a great part of its life in fresh-water, the eel must essentially be considered as a marine fish. The colloid osmotic pressure of its serum has indeed the same value as that of one of the most active marine Teleosteans, that is, *Labrax lupus*.

PAUL MEYER.

Laboratoires Lumière et
Laboratoire de Physiologie générale
de la Faculté des Sciences,

Lyon.
July 21.

¹ P. Meyer, NATURE, 136, 757 (1935); *Compt. rend. Soc. Biol.*, 120, 303, 305 (1935); *J. Physiol.*, 34, 5 (1936).

² P. Meyer, NATURE, 137, 401 (1936); *Compt. rend. Soc. Biol.*, 120, 1004, 1005 (1935); *J. Physiol.*, 34, 448 (1936).

³ A. Keys and R. M. Hill (*J. Exper. Biol.*, 11, 28; 1934) had already measured the colloid osmotic pressure of the serum of three freshwater teleosteans (*Vinca vulgaris*, *Esox luscius* and *Anguilla vulgaris*). The figures reported by these authors agree with the values recorded in this note.

Metabolism of Cartilage

IN reply to the letter of Dickens and Weil-Malherbe¹, a previous communication² on this subject was based, except where rabbit cartilage was specified, on more than one hundred experiments with cartilage from the carpo-metacarpal joints of the adult horse, to whose metabolism that of human cartilage is very similar.

As regards the rabbit, hyaline cartilage from the femur has an anaerobic glycolysis of 1.0 for the first few hours, falling to an average of 0.6 over the 24 hours: the figures cited previously refer to meniscus (fibrocartilage) over a period of 24 hours in an experiment lasting fourteen days. A comparable figure is that for the first hour, 0.6.

Respiration measurements have not yet been made on rabbit material, but it is perhaps of interest:

(1) That the well vascularized epiphyseal cartilage of the foetal rabbit has an anaerobic glycolysis ten times as high as the adult, or, per cell, twice as high.

(2) That a human enchondroma showed a glycolysis thirty times that of normal cartilage and an oxygen uptake of 0.34.

E. G. L. BYWATERS.

Courtauld Institute of Biochemistry,
Middlesex Hospital Medical School,
London, W.1.
July 25.

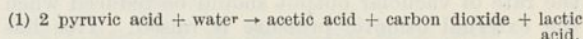
¹ Dickens and Weil-Malherbe, NATURE, 138, 125 (1936).

² Bywaters, NATURE, 138, 30 (1936).

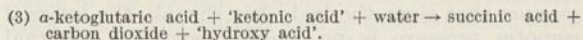
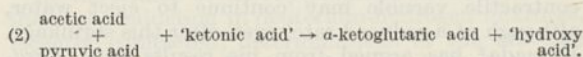
Intermediate Metabolism of Carbohydrates

WE have found some new chemical reactions in living cells which represent steps in the breakdown of carbohydrates. Pyruvic acid, if added to animal tissues, disappears rapidly not only in the presence, but also in the absence of oxygen. In the presence of oxygen the end-products of the pyruvic acid metabolism are known to be carbon dioxide and water. We find that the primary steps of the oxidation proceed in the absence of molecular oxygen, and as products of the anaerobic oxidation the following substances were identified: (1) acetic acid, (2) carbon dioxide, (3) succinic acid.

The reductive equivalent for the oxidation of pyruvic acid is the conversion of another fraction of pyruvic acid into lactic acid or the homologous reduction of another ketonic acid. The quantitative data suggest that pyruvic acid is metabolized by the following intermolecular oxido-reductions: The first step is a dismutation of pyruvic acid according to the reaction:

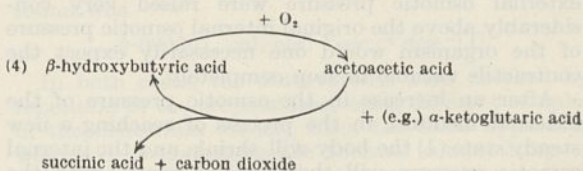


The evidence for the occurrence of this reaction in the tissues which metabolize carbohydrates is conclusive. The subsequent reactions which lead to the formation of succinic acid may be tentatively formulated in the following way:



According to (2) α -ketoglutaric acid is formed by the oxidative condensation of pyruvic and acetic acids, a ketonic acid acting as hydrogen acceptor. According to (3), α -ketoglutaric acid is oxidatively decarboxylated by dismutation. Reaction (3) is analogous to (1).

The experiments suggest that different 'ketonic acids', such as pyruvic acid, acetoacetic acid, oxalacetic acid¹, or their homologues may be concerned in reactions (2) and (3), and may possibly take the place of pyruvic acid in (1). It seems that acetoacetic acid reacts preferentially in (3), and it is therefore of great interest that we find in tissues which metabolize carbohydrates a specific system which catalyzes the oxidation of β -hydroxybutyric to acetoacetic acid by molecular oxygen²; β -hydroxybutyric acid may thus act as a carrier for molecular oxygen according to the scheme (4).



As is indicated in (4), α -ketoglutaric acid is not directly oxidized by molecular oxygen, but through the intermediation of another ketonic acid. It has long been known that there are links between carbohydrate breakdown and 'ketone bodies', and it is now possible to describe this link, or at least one of the links, in chemical terms.

The oxidative formation of succinic acid from pyruvic acid has been discussed by previous workers.

The new feature is the demonstration that this oxidation is brought about by anaerobic oxido-reductions. The reactions described seem to occur in all animal tissues which metabolize carbohydrates. They occur also in bacteria. Reaction (1), for example, is quantitatively realized in gonococci.

The work of Peters³ and the findings of Simola⁴ suggest that vitamin B₁ is a co-enzyme for dismutations of the type of the reactions (1) and (3). Experiments on tissues of vitamin B₁ deficient rats and chickens show that such is the case.

H. A. KREBS.

Department of Pharmacology,
University, Sheffield.
July 9.

¹ See also A. Szent-Györgyi, *Z. physiol. Chem.*, **236**, 1 (1935).

² See also M. Jowett and J. H. Quastel, *Biochem. J.*, **25**, 2181 (1935).

³ R. A. Peters, *Lancet*, May 23, 1936.

⁴ P. E. Simola, *Suomen Kem.*, **9**, B, 4 (1936).

Length of Saccharide Chains in Glycogens from Different Sources

EMPLOYING Haworth's 'end-group assay' method, it has already been shown that rabbit liver glycogen formed under normal conditions has a chemical molecule built up of a chain of 12 glucose units^{1,2}. Fish (Gadidae) liver glycogen also conforms to this structure².

Haworth afterwards recorded that glycogen (source not mentioned) may also exist derived from 18 units³.

I have now examined, by the above method, the glycogens (a) laid down in the liver after oral administration of galactose to fasted rabbits; and (b) from the whole tissue of *Mytilus edulis*. In each instance the mean number of glucose units in the chemical molecule of the polysaccharide has been found to be 18.

This fact was revealed only following examination of the cleavage products of the methylated glycogen in question. No apparently significant differences from 12 unit glycogen could be demonstrated by examination of the purified polysaccharides themselves with respect to $[\alpha]_D$, reducing power, rate of hydrolysis, or properties of the acetylated or methylated derivatives.

These investigations will be fully reported through the usual channels.

DAVID JAMES BELL.

Biochemical Laboratory,
Cambridge.

¹ Haworth and Percival, *J. Chem. Soc.*, 2277 (1932).

² Bell, *NATURE*, **136**, 184 (1935); *Biochem. J.*, **29**, 2031 (1935).

³ Haworth, Pres. Add. to Chem. Sec. of Brit. Ass., p. 41 (1935).

Inhibitory Effect of Phloridzin and Phloretin on Kidney Phosphatase

THE inhibitory effect of phloridzin on phosphatase action¹ is well pronounced only when rather high concentrations (about *m*/50-*m*/100) of the poison are used. The phloridzin concentrations which are able to prevent any reabsorption of glucose in the kidney are definitely lower² (about 0.5-1 mgm. per gm. kidney). Phloridzin is hydrolyzed by *N* hydrochloric acid at 100° into glucose and phloretin.

The present communication shows that the inhibitory effect of phloretin on kidney phosphatase is

about three to four times as high as that of phloridzin. In alkali at 100° the phloridzin is hydrolyzed into phloroglucin-glucoside and phloretin acid. Here also an increase in the poisonous action (about twice) is observed. Phloroglucin has no poisonous action on phosphatase; pure phloroglucin-glucoside has not been tested. However, phloroglucin-glucoside inactivates the reabsorption of glucose in the kidney³.

Exp. 24/6. Kidney phosphatase; veronal buffer pH 8.5; temp. 38° C.; incubation, 60 min.

Substrate : glycerophosphate	Ester hydrolysis (mgm. P)	Per cent inhibition
Normal sample	0.350	
Phloridzin <i>m</i> /370	0.292	15
Phloretin <i>m</i> /370	0.152	57

In this connexion, it is of interest that liver and kidney contain great amounts of β -glycosidases; phloridzin-glycosidase has been found in horse kidney⁴.

H. KALCKAR.

University Institute
of Medical Physiology,
Copenhagen.
July 10.

¹ Lundsgaard, *Biochem. Z.*, **264**, 209 (1933).

² Lundsgaard, *Skand. Arch. Physiol.*, **72**, 265 (1935).

³ Lambrechts, *Compt. rend. Soc. biol.*, **121**, 870 (1936).

⁴ Hoffmann, *Biochem. Z.*, **235**, 429 (1936).

Steady Performance of Geiger-Müller Counters

DUE to rapid discharges that take place in a counter, a considerable amount of gas may easily be liberated, or in some cases even adsorbed, causing fluctuations of pressures in the counters. After working for some time, the voltage initially found to be suitable may no longer be so, and may lie beyond the limits within which the counts are independent of variations of applied voltage. This is more likely to occur with low-pressure counters than with high-pressure ones, since the working range of voltage diminishes with diminution of pressure. Herein lies the cause of unsteadiness.

One way of remedying this unsteadiness is to increase the pressure in the counter; but this necessitates the use of very high voltages to the counter. Two other ways are open. By the use of suitably high resistances between the counter and the battery, the tendency for a heavy arcing discharge to be initiated by the condenser discharge can be checked. Another way is to use a big reservoir in connexion with the counter volume. The large volume makes changes of pressure negligible.

We have found that counters in which no counting range could be detected easily gave such ranges on the insertion of a ten-litre volume. This arrangement was tested for pressures from 5 mm. up to 10 cm. with counters of different dimensions, air being used in all cases. Tinned copper wire of about 0.3 mm. diameter was used for the central electrode. The tinning was done not for any special reason, it being the usual 5 amp. fuse wire. The material of the outer electrode is brass, in thin sheet and enclosed in a sealed glass tube.

B. DASANNACHARYA.

Department of Physics, G. S. RAO.
Benares Hindu University.

Vibrational Frequencies of Molecules

IN a recent letter to NATURE¹, I submitted evidence that the ground state vibrational frequency of a molecule AB was the mean of the frequencies of the molecules A_2 and B_2 provided that A and B belong to the same group of the Periodic Table. I was then unaware of the work of Dr. C. H. Douglas Clark², who had previously arrived at the same conclusion. To account for certain deviations from this rule, he adds the further condition that the frequencies of A_2 and B_2 must not be too dissimilar in magnitude.

If the motion of a diatomic molecule AB be considered simple harmonic, the vibrational frequency ω is given by the expression:

$$\omega = \frac{1}{2\pi} \sqrt{\frac{M_A + M_B}{M_A \cdot M_B} \cdot K},$$

where M_A and M_B are the atomic weights of A and B respectively and K is the force constant. It is reasonable to assume in the first instance that for such molecules as A_2 , B_2 and AB , the force constant K will have the same value. A simple calculation then shows that the above relation between the vibrational frequencies follows if the masses M_A and M_B are of the same order. Consequently the frequencies of A_2 and B_2 should also be of the same order, thus accounting for Clark's second condition.

H. G. HOWELL.

Armstrong College,
Newcastle-on-Tyne.

¹ H. G. Howell, NATURE, 138, 36 (1936).

² C. H. Douglas Clark, Trans. Faraday Soc., 31, 1017 (1935).

Asymmetry in Metallic Zinc and Cadmium

IN the issue of NATURE of February 22, Dr. G. W. Brindley reports on discrepancies in the X-ray scattering factors of zinc and cadmium. The observed values do not lie on a smooth curve. Of the two possible interpretations of this phenomenon, namely (a) the asymmetry of the atom or (b) the asymmetry in the lattice vibrations, Dr. Brindley gives preference to the latter, since the deviations are too large to be explained by (a)¹.

Nevertheless, I wish to say that the possibility of an appreciable variation from a spherical shape of the zinc and cadmium atoms is not altogether out of the question. This opinion is based on the two following observations:

(1) Nineteen of the twenty-one elements having the close-packed hexagonal structure² show a ratio c/a between 1.578₅ (Os) and 1.64 (Ni). This implies variations of only -3.3 per cent and +0.43 per cent respectively from the value 1.633, which corresponds to the case of close-packed spheres. Cadmium and zinc, however, show values of 1.885₉ and 1.856₂ (1.884₂ resp. at 415°), these ratios being 15½ per cent higher. This difference seems to be too large to be explained by thermal oscillations, should this be taken as the reason for the deviations in the case of the other metals.

(2) The following calculation seems to be of still greater weight. In pursuance of the hypothesis that cadmium and zinc atoms are rotational ellipsoids³, the question arises, what would be the shape of the ellipse forming the cross-section, that is, what would be its numerical eccentricity. The answer is given

by the following calculation for cadmium (p =major, q =minor axis):

$$\frac{p}{q} = \frac{1}{\sqrt{1-\varepsilon^2}} = \frac{(c/a)_{\text{ellipse}}}{(c/a)_{\text{sphere}}} = \frac{1.885_9}{1.6333'}$$

and hence $\varepsilon = 0.5002$; that is, equal to 1/2 as precisely as possible⁴. It is difficult to believe that this is a mere chance, especially in view of the considerations mentioned under (1). (There is no intermediate value between 1.64 and 1.856₂).

The foci of this ellipse are situated at the centre of each half of its major axis. It is therefore possible to put a sphere in each half of the rotational ellipsoid, their centres coinciding with the foci and their surfaces touching the vertices and the centre of the ellipsoid. Such a rotational ellipsoid, being a 'quasi double-sphere', can be regarded as a body very nearly related to the sphere as to its degree of symmetry.

K. HERRMANN.

Technische Hochschule,
Berlin.

¹ See also the paper by C. Zener, Phys. Rev., 49, 122 (1936).

² See M. C. Neuberger, "Gitterkonstanten 1936", Z. Krist., 93, 1 (1936).

³ This view has been mentioned by various writers: Hull, Ewald, Hume-Rothery. See also Canfield, Phys. Rev., 35, 530 (1930).

⁴ For zinc at room-temperature with 1.856₂, one gets $\varepsilon = 0.475$, and at 415° with 1.884₂, $\varepsilon = 0.4989$.

THROUGH the kindness of the Editor, I have been allowed to see Prof. Herrmann's letter prior to its publication. I entirely agree that the X-ray results do not exclude the possibility that the outermost electrons of the atoms in metallic zinc and cadmium may depart from having spherical symmetry; one would not expect the completed inner electron shells to have appreciable asymmetry. The possibility of the outermost electrons being asymmetrical, however, is not to be regarded as an alternative explanation of the experimental results, but as something additional to the explanation already given in terms of asymmetrical lattice vibrations. The contributions of the outermost electrons to the scattering factors of zinc and cadmium at all angles for which measurements can be made are so small that one could scarcely hope to measure an asymmetry in their distribution by means of X-rays. On the other hand, any asymmetry in the lattice vibrations will affect the entire atom, and at large scattering angles, measurable effects may be expected if the asymmetry is sufficiently great, and this appears to be so for zinc and cadmium.

With regard to point (1) raised by Prof. Herrmann, it is difficult to see whether this indicates an asymmetry of the atoms or of the lattice vibrations, without going into the matter much more fully. If, however, the unusually high c/a values of zinc and cadmium are associated with strongly asymmetrical lattice vibrations, then one might expect that a 'normal' metal, such as magnesium with $c/a = 1.624$, would not show strongly asymmetrical vibrations. I have recently carried out an X-ray investigation of magnesium similar to the previous experiments on zinc and cadmium, and the results so far obtained suggest that in magnesium the lattice vibrations are very much more nearly isotropic than in zinc and cadmium. These results appear to be consistent with the fact that, whereas in zinc and cadmium the thermal expansion coefficients perpendicular and

parallel to the principal axis are very different, in magnesium they are almost the same¹.

With regard to Prof. Herrmann's second point², that the eccentricity of the ellipsoidal space occupied by an atom in zinc or cadmium is almost exactly 1/2, and that into this space one can place two spheres in contact with their centres at the foci, it is difficult to see what physical significance this geometrical result can have; if one regards the atom as occupying alternately the two foci, the situation is equivalent to a larger vibration along the *c*-axis than normal to it.

Finally, it may be mentioned that since my letter appeared in NATURE, the results for zinc have been discussed in the *Philosophical Magazine*³, and a preliminary account of the cadmium results has appeared in the *Proceedings of the Leeds Philosophical Society*³.

G. W. BRINDLEY.

Physics Laboratories,
University, Leeds.
July 13.

¹ See, for example, a recent paper by E. Goens and E. Schmid, *Phys. Z.*, **37**, 385 (1936).

² *Phil. Mag.*, **21**, 790 (April 1936).

³ *Proc. Leeds Phil. Soc.*, **3**, 200 (April 1936).

Oxide Layer on a Polished Surface

I CAN confirm S. Dobinski's results¹ for copper by my own experiments on polished aluminium². I used a different method, namely, observations of changes in the initial solution potential when polished under paraffin, benzene, water. The conclusion I came to in my paper was that wet "polishing resulted in the formation of an oxide film in close contact with the metal and similar to that formed by heating in air". This seems further evidence that many observations on the so-called 'amorphous' layer may really have been observations on the properties of the oxide.

L. H. CALLENDAR.

16 Sandileigh Avenue,
Withington,
Manchester.

¹ NATURE, **138**, 31, July 4, 1936.

² "The Influence of Boundary Films on Corrosive Action", *Proc. Roy. Soc., A*, **115**, 368 (1927).

Inhibitive Effect of Vitamin C on Toxin Production by *C. diphtheria*

KING and Menten (1935) have reported that guinea-pigs having a high vitamin C storage are less sensitive to diphtheria toxin than are those having a low vitamin C storage. This observation may be important in relation to the pathogenesis of diphtheria infection. We, therefore, tried to ascertain the effect of vitamin C on toxin production by *C. diphtheria* *in vitro*.

Experiments have been conducted on the influence of vitamin C in the culture media on the toxicity of culture filtrates of a toxin-producing strain of *C. diphtheria*. A sterile solution of vitamin C was added to the culture medium in concentrations ranging from 0.05 to 0.125 per cent. The flasks containing vitamin as well as corresponding controls were inoculated with *C. diphtheria*, incubated 48 hours at 30° C., and the toxicity of the filtrates tested by intracutaneous injection in guinea pigs.

Vitamin C added to culture media rapidly disappears on incubation at 30° or 37° C. However, if immediately after the vitamin is added the medium is inoculated with *C. diphtheria*, the vitamin disappears more slowly. But most significant is the

fact that even small residual amounts of the vitamin (20-40 mgm. per cent) are sufficient to inhibit toxin production.

A series of experiments under a variety of conditions has clearly established the fact that vitamin C added in small amounts to a suitable medium inhibits toxin production. The same strain of *C. diphtheria* produces a potent toxin in the flask without vitamin C, and little or no toxin in the one containing the same medium plus the addition of 0.05 per cent ascorbic acid.

It is suggested that the varying toxic character of a diphtheritic injection may depend as much on the tissue saturation with vitamin C as on the toxicogenic properties of the infecting strain. It is also possible that the mildness of diphtheritic infection in subtropical and tropical countries is in some way related to the quantitative differences in the concentration of this vitamin. These questions are being investigated.

I. J. KLIGLER.

Department of Hygiene and Bacteriology,
Hebrew University, Jerusalem.

Induced Chiasma Formation in Somatic Cells by a Carcinogenic Hydrocarbon

EXPERIMENTS are being done on the effects of methylcholanthrene on mouse fibroblasts cultivated *in vitro*. The tissue is grown by the hanging drop method in a medium containing approximately 0.005 mgm. of the hydrocarbon per c.c. and is subcultivated every 48 hours. After three days' growth, the cultures when fixed in Navashin's fluid and stained with iodine-gentian-violet are found to contain a high percentage of abnormal mitotic figures of various types.

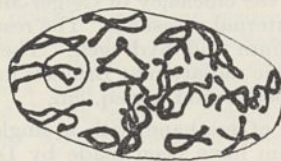


FIG. 1.

Of particular cytological interest is the induction of chromosome pairing and chiasma formation in somatic cells. This condition was observed in several tetraploid cells at various stages from early prophase until anaphase. This disturbance may take the form of a precocity of the prophase in relation to the chromosome splitting, which may also be the underlying mechanism of the induction of chromosome pairing. This suggestion is supported by the abnormal degree of contraction which is observed in the chromosomes both in the cells which show chiasma formation and in the other abnormal cells. The chiasma frequency observed is 1-3 per chromosome as in normal meiosis. A typical prophase cell of this type is shown in the accompanying drawing (Fig. 1) in which some chromosomes have been omitted for clarity.

E. MARIE HEARNE.

(Canadian Federation of University
Women's Scholar.)

Strangeways Research Laboratory,
Cambridge.
July 16.

Isotopes and Molecular Asymmetry

QUITE recently¹, attempts have been made to resolve into their optically active components, molecules of the type $C.H.D.R_1.R_2$, with very slight success, if any at all. In 1922², I suggested that if this type of asymmetry associated with isotopes was responsible for very slight rotation or none at all, a molecule of the type $C.x.y.R_1.R_2$ should be investigated, x and y being atoms or groups of similar electronic configuration. In view of the resemblance (which some physicists consider is a real one) between the electronic configuration of the methyl radical and

the fluorine atom, the molecule of α -fluor-propionic acid might be a fit subject for investigation. This substance may have no optical activity, if the recent results are correct. I am not aware that asymmetric molecules containing CH_3 and F as dissimilar groups have ever been subjected to optical resolution.

T. IREDALE.

University,
Sydney.
July 18.

¹ Erlenmeyer and Gartner, *Helv. Chim. Acta*, **19**, 145, 331 (1936);
Coppock and Partridge, *NATURE*, **137**, 907 (1936).

² *NATURE*, **109**, 779 (1922).

Points from Foregoing Letters

GRAPHS showing the hourly variations in the (square of the) critical penetration frequency (f^2) of radio waves for the C_1 ionizing region of the atmosphere, located at a height of 55 km., are given by Dr. H. Rakshit and J. N. Bhar. Prof. Mitra, commenting on one of their remarks, points out that the critical penetrating frequency cannot be taken as a measure of the density of ionization since it depends upon both ionization density and upon collisional frequency, which vary independently.

An experiment conducted by Chas. R. Burrows on the propagation of ultra-short radio waves over fresh-water shows that a revision of the Sommerfeld-Rolf curves is required in those cases where the dielectric constant is taken into account.

Max G. E. Cosyns has measured specific ionization of cosmic rays in hydrogen, helium and argon by comparing the efficiency of Geiger-Müller counters for different internal pressures. The results are given for argon, helium and hydrogen. The absolute intensity of cosmic radiation at Brussels has been found to be 0.0266 per second per sq. cm.

Forty litres of methane with a single substituted deuterium atom have been made by Drs. W. H. J. Childs and H. A. Jahn, in order to obtain its absorption spectrum in the photographic infra-red. Preliminary results are given and the spectrum compared with that of ordinary methane.

From data obtained by Kox on the amplitude of light variation of three separate wave-lengths in different regions of a pulsating star (δ Cephei), and assuming that Planck's formula for 'black body' radiation holds in such cases, A. E. H. Bleksley concludes that the light variations in cepheid variables is consistent with the view that the radius of their photosphere (layer from which comes most of the light that reaches us directly, that is, without absorption and re-emission) is considerably greater at minimum than at maximum luminosity.

In discussing the osmotic function of the contractile vacuoles of Protozoa, Dr. J. A. Kitching points out that while one might expect the rate of vacuolar output to decrease after the external osmotic pressure has been raised above the original internal osmotic pressure of the organism, one would not necessarily expect the contractile vacuole to stop completely. Changes of body volume, and hence of internal osmotic pressure, must also be taken into account.

According to Dr. P. Meyer, the colloid osmotic pressures of the body fluids of freshwater animals are in the order of phylogenetic development, but 20-35 per cent lower than those exerted by the body fluids of the corresponding marine animals. Regarding the freshwater fauna as a regressive branch of the aquatic fauna in general, this is not necessarily contrary to the hypothesis of a relation between the general organization of an animal and the colloid osmotic pressure of its body fluids.

Dr. H. A. Krebs describes chemical changes which pyruvic acid undergoes in living cells. These reactions are intermediate steps in the biological breakdown of carbohydrates; they shed light on the relations between the metabolism of carbohydrates and of ketone bodies, and on the physiological function of vitamin B₁.

D. J. Bell states that glycogen obtained from the whole tissue of the edible mussel, and also from the liver of fasted rabbits (after oral administration of galactose) consists of 18 glucose units, while the glycogen obtained from the liver of rabbits under normal conditions, or that from fish liver, consists of 12 glucose units. No significant difference in the properties of the two glycogens has been observed.

The action of the phosphatase enzyme of the kidney (which splits phosphoric acid esters) is found by Dr. H. Kalckar to be much more strongly inhibited by phloretin than by its glucoside, phloridzin, a bitter principle in the bark of apple and other trees.

It has been found that the vibrational frequency of a molecule AB is the mean of the frequencies of the molecules A_2 and B_2 when A and B belong to the same Periodic Group and where the frequencies of A and B are not too dissimilar. Dr. H. G. Howell points out that this result follows if the force constant is considered to be the same for molecules within a given group.

Prof. K. Herrmann prefers to ascribe certain discrepancies in the X-ray scattering factors of zinc and of cadmium to the asymmetry of the atoms rather than to lattice vibrations, and gives reasons for his preference. Dr. G. W. Brindley, in reply, maintains his opinion that the lattice vibrations are responsible for the asymmetry and considers that, while the outermost electrons of the zinc and cadmium atoms may depart from spherical symmetry, the inner complete electron shells are not likely to do so.

Research Items

Cultural Associations of Solo Man

DR. P. VAN STEIN CALLENFELS has directed attention (*L'Anthropologie*, 46, 3-4) to the character of certain of the artefacts associated with the skulls of Solo man, when these were found in the alluvial gravels of the River Solo at Ngandong, Java, which apparently are of later date than the gravels of Trinil, from which *Pithecanthropus* was derived. The artefacts were scattered over an adjacent area of about fifty metres. They consisted of worked stones of an indeterminate character, and a number of implements of bone and staghorn (chiefly *Cervus Lydekkeri*) with a quantity of bones, for the most part broken. Their contemporaneity with Ngandong man, it would seem, cannot be questioned. They are now in the Bandoeng Geological Museum of Batavia. A flat harpoon with bilateral barbs would be sufficient alone to justify a comparison with the late Azilian harpoons of Scotland, while certain rare forms of Maglemosian harpoon would also serve for comparison. Even more surprising, however, is the association at Ngandong of these archaic skulls with axes of staghorn, of which analogies can be found only in the Mesolithic. The most ancient reindeer horn axes known have been found in northern Europe and belong to the civilization of Lyngby, the first stage of Childe's Forest Culture. At Ngandong the stem of the horn forms the handle and one of the tines forms the blade of the axe. The Lyngby culture belongs to the pre-Boreal post-glacial, and is a little later than Azilian, say 7000-8000 B.C. While all reserve must be shown in comparing two cultures so far removed from one another as that of Ngandong in Java and the Lyngby culture of northern Europe, in estimating the age of Solo man at Ngandong, the associations of artefacts of similar type in Europe must not be forgotten.

Tibetan Blood Groups

PROF. R. RUGGLES GATES, in studying blood-groups of American Indians, has been led to seek an Asiatic people of similar physiognomy, who might be sufficiently high in the *O* blood-group to have been ancestral to the Indians. One such people, whose blood-groups are wholly unknown, are the Tibetans. Material was obtained through Capt. David Tennant, I.M.S., stationed at Gyantse, Tibet, and the results of its examination are recorded by Prof. Ruggles Gates in *Man* of July. The results, both unexpected and unusual, are as follows: *O*, 28, 14.9 per cent; *A*, 88, 47.1 per cent; *B*, 26, 13.9 per cent; *AB*, 45, 24.1 per cent; total, 187. By applying the formula $\sqrt{N} = \sqrt{(A+O)} + \sqrt{(B+O)} - \sqrt{O}$, it is evident that the results do not depart significantly from expectation in a homogeneous or well-mixed population. Of the numerous blood-grouping results listed by Steffan, only one has a higher percentage of *AB*—a series from South Hungary. Some of the Ainu show 25 per cent *AB*, while the Japanese usually run about 10-15 per cent and some Russian communities have about 15-20 per cent *AB*. It is evident that these results, the first to be published from Tibet, show that the Tibetans are at the opposite pole from the Americans. No record from any other race shows

such a low percentage of *O*. Another peculiar feature is that *AB* is nearly double the frequency of *B*. The percentage of *A* appears to be the highest recorded for Central Asiatic peoples, being definitely higher than the Chinese, and much higher than the Hindoos. A higher percentage of *A* is found only in peripheral peoples, such as the Lapps, Bushmen or Australian aborigines. The Tibetans are then well saturated with the blood-groups, and the result is such as might be expected from a people originally very high in *A* meeting a people, such as the Chinese, with a high proportion (c. 35 per cent) of *B*.

Reindeer Grazing

IN relation to the pastoral possibilities of the North-West Territories of Canada, some conclusions drawn by Mr. E. Porsild, who has spent several years in charge of experimental herds of reindeer, are contained in an article in the *Geographical Journal* of July. Apart from lake areas and rocky ground that exclude large areas, the ubiquity of insect pests, notably the mosquito, seems to be the limiting factor. Except in the arctic archipelago and along the sea-coast of the mainland, flies and mosquitoes occur throughout the North-West Territories in such enormous numbers during the short summer that "neither the reindeer nor the hardiest of herders can endure their movements". The only escape from these pests is to move the herds to the sea-coast in June and July. There are no hills of sufficient height to be clear of mosquitoes. However, all the Canadian Eskimo tribes without exception live on the coast, and are thus potential reindeer herders. Mr. Porsild considers that among the areas suitable for reindeer grazing, the best is on the west coast of Hudson Bay. An area east of the Mackenzie delta will support great herds, and is now in use. So far, the introduced Alaskan reindeer seem to be doing well.

German Copepods

DR. OTTO PESTA has completed his account of the copepods of Germany and adjacent seas ("Die Tierwelt Deutschlands und der angrenzenden Meeressteile nach ihren Merkmalen und nach ihrer Lebensweise". By Prof. Dr. Friedrich Dahl and others. Teil 29. Krebstiere oder Crustacea. 1: Ruderfüusser oder Copepoda (4, Monstrilloida; 5, Notodelphyoida; 6, Caligoida; 7, Lernaeoida). Jena: Gustav Fischer. 6 gold marks). This is a specially interesting and important part of the section dealing with the Copepoda as it contains the parasitic and semi-parasitic forms. Of the Monstrillidæ, which are planktonic in the adult state and the larvæ of which inhabit polychætes (or, exceptionally, a mollusc), there are four species recorded here, and of the Notodelphyoida, which are commensals or true parasites in echinoderms, ascidians or *Cephalodiscus*, there are three species recorded. All the rest belong to the Caligoida and Lernaeoida, both groups represented by numerous species. This is a most useful summary, and is well up to the standard of the former parts, the whole being an indispensable reference book for all working in these regions.

Porcine Trypanosomiasis

HOARE has shown by an exhaustive study (*Trans. Roy. Soc. Trop. Medicine and Hygiene*, 29, No. 6; 1936) that *T. simice* is the trypanosome responsible for acute trypanosomiasis of the pig—an animal little subject to infection by the pathogenic trypanosomes of other domestic animals. Contrary to what was originally thought, it is a polymorphic form, which no doubt accounts for the list of aliases under which it has masqueraded. The intermediate host is the tsetse fly, *Glossina morsitans*, and possibly other species, and the reservoir host is the wart-hog. The etiology and epidemiology of the parasite are discussed.

Varietal Difference in the Potato

THE text of a lecture on "Recent Developments in Connection with the Potato", recently delivered by Dr. T. P. McIntosh before the Royal Caledonian Society, appears in the *Gardeners' Chronicle* of June 6, 13, and 20. Much work relating to the place of origin of the potato was reviewed, and some recent work in Russia suggests that the Peru-Bolivian plateau and south Chile were the two original centres. Dr. McIntosh dealt with his own work on the observation of varietal differences in potatoes, and their detection by chemical means. A test with dilute caustic potash causes the petals, or the flesh of the tuber of some varieties, to turn a vivid canary-yellow. Oxidase tests may also be applied to the tuber for the detection of certain varieties, and the variety Golden Wonder gives an electric-blue fluorescence with ultra-violet light, where other kinds appear red-purple. Characters of tuber sprouts may also be used for diagnostic purposes, and some very interesting colour correlations are set forth. Various experiments on potato breeding are described, and modern work on virus diseases, blight, and other subjects, is reviewed.

Spray Covering on Apples

A SHORT paper by Messrs. Kermit Groves and James Marshall (*J. Agric. Res.*, 51, No. 12, 1139-1142, Dec. 1935) directs attention to the fact that spray fluids applied to fruit crops are often deposited very unevenly upon the developing fruits. They show that more than a third of the total wash received by an apple fruit may collect round the depressions at the calyx and stem ends, and recommendations for estimating spray covering are set forth involving a degree of accuracy which, however, scarcely seems justified in a problem of this calibre.

Vapour Pressure of Deuterium Water

IT is known that the vapour pressure of deuterium water is smaller than that of ordinary water and that the difference becomes smaller as the temperature is raised. F. T. Miles and A. W. C. Menzies (*J. Amer. Chem. Soc.*, 58, 1067; 1936) have determined the pressures for deuterium water at temperatures from 20° to 230° C. by a differential tensimetric method. The results could be reproduced only by a five-constant equation: $\log r = -16.998671 + 268.8426/T + 7.4971604 \log T - 9.761107 \times 10^{-3} \times T + 4.4288 \times 10^{-6} \times T^2$, where $r = p_{D_2O}/p_{H_2O}$. The normal boiling point of D₂O is calculated as 101.40° ± 0.016°. The temperature at which the vapour pressure of the two varieties of water is identical is calculated as 224.3°, which may be within 0.5° of the truth. Values for the excess of the latent heat of evaporation of D₂O

over that for H₂O are calculated. They vary from 300 gm.cal. per mol. at 40° C. to 115 at 220° C. The value at 70° agrees with that found by Lewis and Macdonald for measurements between 20° and 90°.

Exchange Reactions with Isotopes

E. OGAWA (*Bull. Chem. Soc. Japan*, 11, 367, 425, 428; 1936) has described some experiments on the interchange of hydrogen and deuterium in urea, glutamic acid and asparagine and also in carbohydrates, and on the isotopic separation of oxygen, chlorine, bromine and nitrogen by chemical methods. In a further communication to the Editor, he claims to have achieved a separation of nitrogen isotopes by the following method. One kgm. of ammonium chloride (Sample A) in 3 litres of water was converted into ammonia (assumed to be NH₃OH₂) by the weighed amount of caustic soda. The ammonia was distilled off and the ammonium chloride was decreased to 47.5 gm. (Sample B). This was again decreased to 1.34 gm. (Sample C). By interaction with silver nitrate the atomic weights of nitrogen in the samples were determined as 14.002 (A), 14.023 (B) and 14.105 (C). Samples B and C would then contain 1.61 and 10.5 per cent, respectively, of N¹⁵ and the separation coefficients would be 5.0 and 3.1. The method depends on a theory of the author according to which the element is richer in heavier isotope when it is in the more positively polarized state. The interchange reaction is N¹⁴H₄+Cl⁻ + N¹⁵H₃OH₂ = N¹⁵H₄+Cl⁻ + N¹⁴H₃OH₂.

Plaster of Paris

IT has generally been assumed that plaster of Paris is the hemihydrate of calcium sulphate, CaSO₄, ½H₂O, which on setting takes up water to form gypsum, CaSO₄, 2H₂O. Some recent investigations on various lines have been held to show that the water in gypsum is lost on dehydration without any intermediate formation of a lower hydrate, and thus it necessarily follows that plaster of Paris is not a definite hydrate but contains water bound in the state found in zeolites. H. B. Weiser, W. O. Milligan and W. C. Ekholm (*J. Amer. Chem. Soc.*, 58, 1261; 1936) have now published results of X-ray diffraction studies which seem to show that the hemihydrate and dehydrated hemihydrate have not identical structures, as has been asserted. The X-radiograms of the two substances are similar, showing that the structures are similar, but the existence of definite characteristic differences between the two patterns indicates that the water molecules in the hemihydrate occupy fixed positions in the lattice. The results support the view that the hemihydrate is a definite chemical individual, and that the process of dehydration is not zeolitic in character. The isobaric dehydration curves of gypsum also show a very definite break at the composition of the hemihydrate, although both this and anhydrous calcium sulphate adsorb water. The failure of some previous investigators to notice the difference in the X-ray patterns may be due to the use of too small cameras, molybdenum radiation, and failure to use a reference material for standardizing the films. There can be no doubt, the present authors state, that significant differences exist between the X-radiograms of the hemihydrate and its dehydration product when use is made of a relatively large camera, copper radiation, and a standardizing material, and when special care is taken to avoid rehydration of the dehydrated hemihydrate.

Second International Congress for Microbiology

THE week of July 27–August 1 saw more than a thousand microbiologists from all over the world united in conference at University College under the presidency of Dr. J. C. G. Ledingham, director of the Lister Institute. Six years have elapsed since the first Congress in Paris, the original triennial plan having fallen through for reasons which, in view of the world-wide political and economic unrest, may readily be imagined. Much new and important work was therefore ripe for discussion, and the scientific programme had to be divided into no less than eight sections, devoted each to a special subject.

Section 1, under the presidency of Prof. E. Gotschlich, formerly of Heidelberg and now of Ankara, Turkey, dealt with the general biology of micro-organisms. Selective bacteriostasis (the inhibitory action of such substances as dyestuffs and the products of their own metabolism on the growth of bacteria and fungi) and the preservation of micro-organisms in suspended animation, so to speak, by drying in the frozen state were two of the subjects most actively discussed. Their importance is both theoretical and practical: the latter subject especially, interesting in itself in its implications as regards resting states in more highly organized living creatures, has become practically valuable, since it has been realized how subject to variation the unicellular microbe is during culture in the laboratory, particularly variation by loss of such original properties as virulence.

Section 2, devoted to the viruses and virus diseases in animals and plants, under the presidency of Prof. Doerr, of Basle, had perhaps the greatest body of observations to consider, nearly all new since 1930. The five days of discussion, on the general characteristics of viruses, on the modes of transmission and paths of infection in virus diseases, on the evidence concerning the agency of viruses in the ætiology of new growths and on the mechanism of immunity in virus infection, with its practical applications, might alone have furnished material for a congress. Besides the plant diseases in which 'virus' was first discovered, the common cold and influenza, foot-and-mouth disease of cattle, psittacosis, hydrophobia, yellow fever and malignant tumours were all considered in the light of their experimental production by filtrates from which all but 'ultra-microscopic' life had been removed. Astonishing progress was reported in measuring particles of living matter possessing such pathogenic properties, particles not much greater in size than the molecules of comparatively simple chemical compounds, in purifying them and in studying their behaviour in the body fluids of infected and immune subjects: it is gratifying to note how much of it lies to the credit of British research work.

As Bordet put it, in his address as past president to the general assembly of the Congress, "il n'est point de problème plus passionnant, puisqu'il comporte l'étude de la vie dans ces mystérieuses profondeurs où les dimensions deviennent tellement petites que parfois l'on se demande si l'on est encore en présence d'êtres vivants et si les phénomènes qu'on observe ne sont pas dûs à des principes chimiques doués de propriétés imprévues." Yet

these particles have been rendered visible and, as 'elementary bodies', have been collected in suspensions of which a dilution of a millionth or more may still produce disease, and multiply indefinitely. Whether they can so multiply apart from the living tissue is yet unsettled: it seems rather that their reproduction is inseparable from the living cell and may indeed be actually a derangement of the cell's own life process.

Section 3, on bacteria and fungi in relation to disease in man, animals and plants, under the joint presidency of Dr. E. J. Butler of the Agricultural Research Council and Prof. H. Zinsser of Harvard, seemed almost staid and commonplace after such adventures in the unknown. Its subjects of highest interest, perhaps, were (1) the general one, on the significance of serological and cultural types of the pathogenic bacteria and fungi in relation to epidemic, epizootic and epiphytotic outbreaks of disease, and (2) the special discussion on the pathogenic streptococci which appear to cause more varied and widespread human misery and death than any other bacterial species.

Section 4, on economic bacteriology, under the presidency of Prof. R. E. Buchanan of Iowa, U.S.A., had to be divided into three subsections: (a) dairy, (b) water, including sewage and industrial fermentations, and (c) soil microbiology. Each of these had its own specialists conferring on its particular problems, but joining with the other subsections for discussion of a subject of general interest, the metabolism of yeast.

In Section 5, on medical, veterinary and agricultural zoology, with Prof. E. Brumpt of Paris as its president, the most active discussion was that on typhus fever and the rickettsias, with chemotherapy of protozoal infections as a close second. The author of "Rats, Lice and History", Prof. Zinsser, appropriately opened the discussion on the former. The similarities and differences, clinical and serological, in the great 'typhus group' of fevers have all been defined in quite recent years; the biology of the infecting microbes, the rickettsias, is, moreover, of particular interest in relation to life-cycles in bacteria, a fascinating field scarcely yet open to exploration.

Section 6, on serology and immunochemistry, was to have been presided over by the arch-priest of the doctrine of antigenic specificity, Prof. Landsteiner of the Rockefeller Institute. Unfortunately prevented, he was replaced by Dr. P. Hartley of the National Institute at Hampstead, himself a serologist of distinction. The study of antigenic structure—and especially of the structure of the new synthetic antigens, the subject of a joint discussion with Section 7—as the new tool for investigating the architecture of living matter, took almost the whole week of the section's time, though it found a day for the significance of allergy in disease, both as a general hypothesis in pathology and as an explanation of such special cases as the cotton-dust asthma, recently elucidated by Prausnitz in Manchester.

Section 7, on microbiological chemistry, had, naturally, Sir Arthur Harden as its president, and

a particularly long and varied list of contributions, ranging over growth factors in bacterial culture to the influence of substrate on the chemical potentialities of the cell.

Section 8, on specific immunization in the control of human and animal diseases, was presided over by the veteran Prof. W. H. Park of New York. Its programme was the longest of all, since its subject is the immediate practical concern of health officers in every country, all of them anxious to compare notes and to learn new methods in the prophylaxis of disease. Whooping cough, pneumonia, cerebrospinal fever and the streptococcal infections already mentioned were the chief human diseases in which progress was reported in protective and curative immunology, while in veterinary practice the various anaerobic infections, especially, had victories to relate since 1930.

So much for the set discussions: perhaps even more valuable, since they dealt with speculations too young and tender for the rough handling of public debate, were the private conversations during the afternoons free from open sessions. How many of these there were, one can judge only from observation of numerous groups of well-known workers with their heads together in eager talk. Such intercourse

may well be the most fertile of all the Congress activities.

A full programme of 'scientific visits' had been arranged for the Congress members and most of the well-known institutes for microbiological research in and near London were 'at home' to visitors on at least one day during the week. The Ladies' Committee had, in addition, organized general excursions for sight-seeing round London which proved extremely popular. The Universities of both Oxford and Cambridge invited and entertained with generous hospitality large parties of Congress visitors.

The Congress closed on August 1 with a plenary session at which resolutions for the alteration of the name and statutes of the original International Society for Microbiology were adopted. Future triennial congresses are no longer only one of the activities of a society, in the sense of a body of society members, unlimited in number, but of a new 'Association of Microbiologists', limited in function mainly to congress organization and in number to one delegate from each participating country. Under the new constitution, the United States invited microbiologists to a congress in 1939 to be held in August on the Atlantic seaboard, and this invitation was accepted by the plenary session with acclamation.

Fruit Supplies in 1935

UNDER the above title, the Imperial Economic Committee has issued a comprehensive supplement to its weekly fruit intelligence notes (London: H.M. Stationery Office, June 1936. 2s. 6d. net). It will surprise most citizens of the United Kingdom to know that only 79 lb. of fruit per head of the population was eaten in 1935, as against an average of 96 lb. in 1934. Imports of raw fruit, however, exceeded those of any previous year, and made a total of 1,480,000 tons. It is gratifying from an Imperial point of view that 53 per cent of this quantity came from Empire countries overseas, and the amount from this source was greater than the total imports from all sources in the years immediately preceding the Great War.

Home supplies show a rather disturbing variation from year to year, though the acreage under fruit crops does not fluctuate greatly. This is shown in the accompanying table, compiled from information on pages 12 and 14 of the volume, and relating to the orchards and small fruit in England and Wales:

Year	Acreage	Yield, in cwt.
1929	313,295	11,098,000
1930	313,188	10,116,000
1931	306,801	5,371,000
1932	306,839	5,896,000
1933	309,553	9,445,000
1934	315,890	16,217,000
1935	321,963	4,387,000

would find a more uniform and workable market. The reason why the average consumption of fruit was 17 lb. more in 1934 than in 1935 seems to be that there was more than 3½ times the quantity from home sources in the former year than in the latter. Imports could not account for the increased consumption, for 27,069,000 cwt. of fruit came into the country in 1934, and only a slightly larger amount, 29,593,000 cwt., in 1935. Damage by frost may possibly explain the extremely low yield of 1935, though it was not wholly responsible for the small quantities produced in 1931 and 1932. It remains a potent factor, however, as a cause of fluctuating yield, and is beginning to receive the scientific study it deserves.* The so-called "biennial habit" of fruiting, where a year of high yield is followed by a lean season, is not obvious in the returns set forth above. Could not the growers and scientific workers of the country turn their attention to this rather obvious gap in the development of scientific distribution and controlled cropping?

"Fruit Supplies" gives very extensive analyses of the imports of fresh fruit, vegetables, flowers and bulbs into the United Kingdom, and reviews the output of various sources of supply. A useful feature is the statistics of imports into other countries, and the survey should be welcomed by all who are interested in watching the development of Empire resources.

* For example: B. O. Mulligan, "The May Frosts at Wisley", *J. Roy. Hort. Soc.*, **60**, 10 (Oct. 1935); A. N. Rawes, "An Orchard-heating Experiment", *ibid.*, **60**, 11 (Nov. 1935); J. Grainger and A. L. Allen, "The Internal Temperature of Fruit tree Buds", *Ann. App. Biol.*, **23**, 1 (Feb. 1936); T. N. Hoblyn, "Spring Frosts at East Malling 1915-35", *Ann. Rep. East Malling Research Station for 1935* (May 1936).

If the yearly amount of home-produced fruit could be made more or less stable, the consumer would have the benefit of an increased, healthy diet of fruit, whilst the home producer and the importer

The Hammond Organ

By Sir James Barrett, K.B.E., C.B., C.M.G.

A GENEROUS but anonymous donor has just presented a Hammond organ to the University of Melbourne; and as I am interested in music, especially orchestral music, I am glad to testify to the excellent results obtained from it. The instrument itself is about the size of a small harmonium; it has two manuals and a pedal register, and a foot lever for producing variation in volume. When used fully, the volume of tone is very great, but the musical beauty of the instrument lies even more in the solo stops or arrangements. The clarionet stop produces something superior to any clarionet I have heard, and the volume of tone can be altered at pleasure. The oboe and violin equivalents are very satisfactory.

By combining the various overtones it is obvious that any instrument can be imitated and even improved. The only adverse criticism I have heard is that when the instrument is used fortissimo it is apt to produce a somewhat raucous tone, but that is a matter for the organist to rectify. As the instrument costs about £800, it seems unlikely that many expensive pipe organs will be built in future; and I have no doubt that the Hammond organ represents the commencement of a new development in music.

The following account of the mechanism was kindly furnished me by the professor of physics in the University of Western Australia, Dr. A. D. Ross:

"A synchronous motor rotates at constant speed a shaft provided with sixty-one iron disks, each fitted with a series of projections like teeth. The speed of rotation and the number of projections is such that for any disk the number of projections passing a given point per second is equal to the frequency of the note represented by the disk. When a key of the keyboard is depressed, a magnet is brought close up to the circumference of the associated disk. The passage of the projections of the iron disk causes periodic fluctuations in the magnetic field of the magnet, and consequent induced current in a coil wound on the pole piece of the magnet. The electro-

motive force for this current varies harmonically, so that the current when supplied to a loud speaker gives a sine-wave movement to the speaker diaphragm and therefore a pure tone. (Unfortunately the material of the diaphragm has its own natural harmonics which are introduced to a slight extent into the tone, and this is one of the chief practical defects in the instrument.)

"When the key middle C of the keyboard is depressed, not only is a magnet brought up to the disk corresponding to frequency 256, but other magnets to the disks for 512, 768, 1024, etc. (the overtones). Each gives alternating electromotive forces with the above-mentioned periodicities, and resultant currents. These currents all pass through separate variable resistances, controlled by the draw-stops (each of which can be moved in or out in eight stages) and so one can utilize the series of electromotive forces corresponding to frequencies 256, 768, etc., in any desired degree of intensity. When the electromotive forces, so adjusted, are applied to a circuit, a current flows with fluctuations corresponding to all the effects superposed. This is amplified and transmitted to the loud speakers, which must produce a sound which has the same fluctuations and is the combination tone with the several harmonics present in the arranged proportions.

"The sounds given out by orchestral instruments have been investigated by recording the air pressure fluctuations in each wave. These waves are then analysed by Fourier analysis, either mathematically or experimentally, and the harmonics present are found and their relative intensities. (The problem is identical with that of tidal analysis.)

"The Hammond organ can undoubtedly produce a wealth of tone shades different from those of any known instruments. I found it most interesting when experimenting with it to alter a tone in a series of steps (each of which was in itself practically imperceptible) from that of a clarinet to that of the flute or oboe."

Industrial Use of Electric Batteries

ELECTRICAL engineers have recently been considering the relative merits of vehicles driven by electric batteries and of those driven by petrol. Considerable difference of opinion exists on this point, and so the paper by Dr. Strohe, of Cologne, a translation of which appears in *World Power* of June, is of value as he gives the results of practical tests on the two classes of vehicle.

Dr. Strohe summarizes the relative performances of an electric and a petrol vehicle as follows. Electric vehicles have a life of twenty years and their maintenance costs are five per cent. Petrol vehicles have a life of ten years and their maintenance costs are ten per cent. The 'fuel' costs of the latter are

about four times greater than that of the former. The capital cost of the large electric vehicle is now lower than that of a petrol vehicle of similar loading capacity, and in addition the oil required is less and the tires last longer. The economic advantages, therefore, are in favour of the electric vehicle. The results show that the daily performance of an electric commercial vehicle after several years' use lies between 18 and 24 miles, and it can double this distance on one battery charge. Electrical vehicles are now available with speeds up to twenty miles per hour; but the radius can be extended by increasing the size of the battery. Increasing the size of the batteries is only advantageous when the

batteries are in full-time use. Otherwise the heavier batteries mean additional non-paying load.

When the huge alternating current network of the Grid supply was completed, many thought that there would be little further use for storage batteries in connexion with lighting supply. Having practically obtained standardization, it is most unlikely that Great Britain will ever drift back into the large variety of voltages and systems of supply which existed before the advent of the Grid. There have been a few breakdowns and blackouts since the early years of its working, but their number is diminishing. In *Electrical Industries* of May 6, E. C. McKinnon raises the interesting point whether their number is not a secondary consideration to the question of the possibility of their ever occurring at all. The national supply is now so great that to consider emergency duplicates or alternatives for all of it is impracticable, but there are many sections of the community which might be imperilled in the absence of light and power. Statistics show that the list of installations where an alternative supply has been provided so as to be available in the remote possibility of the cutting off of the main supply by storm, riot, enemy's action, etc., is rapidly mounting. Engineers who have been studying the question of emergency plant recognize that there must be no appreciable time lost after a breakdown in putting it into commission.

It has been customary in the past to regard the average working life of a battery of the stationary type to be something over ten years. But this assumes that the battery has been working during this period.

A battery that is only used for standby purposes has a much longer life. It is unlikely that any system of telephone supply would be run solely from the public mains. There is always a storage battery in reserve and so continuity of supply is assured. Proprietors of cinemas are compelled by law to install a lighting supply secondary to the main supply.

The use of the storage battery as the nucleus for the alternative supply is now firmly established. In several hospitals the storage battery is introduced as a means of assuring constant illumination. The chances of interruption of the public supply are very small, but the outlay required to ensure an unflinching brilliant illumination by a storage battery with automatic control is not a serious item and might possibly save the life of a patient. In stores and public buildings the object of installing automatic emergency lighting devices is to prevent panic amongst those present and the prevention of pilfering should there be a breakdown of the main supply.

In central electric stations and electricity works standby batteries are much used to help carry over the peak loads and so delay the inevitable purchase of more generating plant. A large standby battery in a London supply station was kept fully charged by allowing a 'trickle' of current to flow continuously through it. When recently subjected to the annual examination it was found, for all intents and purposes, to be equal to new after nine years' running.

Turf Nurseries

THE experimental planting work carried out by Sir John Stirling Maxwell at Corroun in Inverness-shire over a long period of years has attained an almost, if not complete, world fame. It was a study of the Belgian system of turf planting which gave Sir John his first successes at Corroun. Since then he has inaugurated what may be considered a sound technique in afforestation work in this type of country.

Sir John has now applied the wide experience gained to the nursery. In the *Scottish Forestry Journal*, 50, Pt. 1 (Edinburgh, March 1936), he describes his method in an article entitled "Turf Nurseries". It is obvious, says the author, that the method has a restricted application; it can only be practised where peat beds are available. The method was suggested by the ease with which it was found possible to move trees planted on upturned turfs for several years after planting. The method is described as follows by the author:

"An area of peat is selected free from roots and boulders. Nothing is more suitable than the *Molinia* flats which are found on nearly all Scots moors. Turfs are lifted and turned over in continuous rows, leaving a space between the trenches from which they are taken just wide enough to carry the line of upturned turfs. These nurseries are best prepared in the autumn and planted in the spring, but this is not essential. The plants are inserted in the centre of each turf, a plug being cut out by a circular spade. A dressing of manure mixed with sand or gravel is

applied to the roots of each plant. The plug is broken up and used to fill up the hole. Well-grown 2-year seedlings are the best plants for the purpose. As regards species, we have hitherto only used Sitka and Norway spruce and *Contorta* pine, but Japanese larch, which grows well on certain types of peat, should be equally suitable. As regards the size of nurseries, the ideal arrangement would be to have each nursery just large enough to plant an acre so that no plants would have to be carried more than thirty yards. In practice we have generally found it more convenient to make the nurseries rather larger, since the number of suitable sites is limited. After two years' growth in the nursery the plants are ready to move. They are carried on hand barrows, six or eight turfs to a barrow. Enough plants are left in position to make the nursery part of the wood. For Sitka we leave every fifth plant in every other row. For Norway every fourth plant. The remainder are set out at whatever distance is desired. If the heather is long a space has to be cut or pulled for each turf. Sometimes on very steep slopes it is necessary to make a nick to prevent the turf sliding downhill. The setting out is usually done as soon as the second year's growth is complete. It may be asked why the turfs are not cut where required and placed at once in their permanent positions. The answer is that there is great economy in concentrating all the preparatory work in one spot. Also the turfs are heavy to handle when first cut, whereas after two years' exposure they become much lighter."

Sir John states that the advantage of the system is that the plants receive no check at any stage in their growth; that the method can be used with success on ground where planting in pits or notching would result in prolonged check; and finally, where draining is required, it does not make up for the lack of it. The author discusses the types of countryside on which he thinks the method is applicable. He says that the turf nurseries require little shelter. Nurseries placed on exposed salients at 1,600 ft. in Scotland have produced plants which "would do credit to any lowland nursery". As regards manures, the old Belgian recipe of one part of slag to seven of sand has given the best results.

Sir John is modest, and thinks the scope of the method is limited. This is by no means so certain. There are parts of the Empire, by no means restricted to peat lands, where it is possible that this type of nursery rearing of plants might be applicable both with success and cheapness.

Educational Topics and Events

CAMBRIDGE.—Applications for a John Lucas Walker studentship in pathology are invited and should be sent before September 30 to Prof. H. R. Dean at the Department of Pathology, to whom requests for further information regarding the studentship may be addressed. This studentship will be tenable for such period and will be of such annual value not exceeding £200 as the professor of pathology with the approval of the Managers may determine.

The Board of Management of the Frank Edward Elmore Fund will shortly proceed to the award of not more than three or four studentships for research. The studentships are open to male graduates of any University in any country who were born at any place within the British Empire other than Scotland. The students first appointed will work in the Department of Medicine under the direction of the regius professor of physic. The commencing salary will be £300 a year.

At Clare College, Prof. R. S. Hutton, Goldsmiths' professor of metallurgy, has been elected into a professorial fellowship.

At Emmanuel College, the external studentship offered to graduates of other universities intending to commence residence as research students in October next has been awarded to C. O. Hutton of Otago University, New Zealand, for research in geology.

SCIENTIFIC research is made self-propagating by the peculiar methods in use by the Wisconsin Alumni Research Foundation. As explained in "A Decade of Service" recording achievements of the first ten years, 1925-35, of the Foundation's existence, this trust started with no invested capital but only a patent application belonging to one of the University professors, Dr. Harry Steenbock. The application, then pending before the United States Patent Office, related to the use of ultra-violet rays to enrich the vitamin D content of foods and medicinal products. A corporation was formed to exploit this patent and any others that might be similarly acquired from members of the University. In ten years the earnings of the Steenbock patent alone have enriched the University by nearly 700,000 dollars and provided an endowment worth more than 125,000 dollars a year for the future needs of research.

Science News a Century Ago

Use of Coal in American Steam-boats

ACCORDING to Admiral Preble, up to the year 1834, steam-boats in the United States burnt wood only. On August 18, 1836, *The Times* published a note from the *New York Evening Star* about the steam-boat *Novelty*, which said that "recent successful experiments of driving this boat, of the largest class, with anthracite coal, against the tide and a strong current at 16 miles an hour has caused much remark in the city, as an astonishing fact of great importance on the subject of fuel which may lead to revolutions in steam navigation. Dr. Knott, the distinguished president of Union College, is the proprietor of the *Novelty*, which he constructed, we believe, with machinery after his own ingenious invention. The fact of the practicability of using anthracite being now ascertained so as to produce as great a degree of heat as pine-wood, will no longer compel steam-boat proprietors to import their wood at exorbitant prices from the remote forests of Maine and the shores of the Chesapeake. Nearby, and almost at our doors, we have the anthracite coal mines of Pennsylvania, of every possible variety, in exhaustless quantities. The successful navigation of the Atlantic from America to Europe is made certain. Wood is now selling at the Hudson, at five or six dollars a cord. The cost, in fact, of pine-wood is about double that of anthracite."

Progress of Ballooning

IN 1836, balloon ascents were very frequent, and considerable sums were paid by passengers desiring to make an aerial voyage. The subject was one of great public interest, and on August 18, 1836, *The Times* in an article on "Aerostation" gave a chronological account of some of the landmarks in ballooning. In this article it said on September 19, 1736, J. Montgolfier sent up a balloon in Paris, filled in eleven minutes with the smoke of burnt straw and wool. Montgolfier then made a balloon of spherical form 45 feet in diameter and 75 feet high in which Pilatre de Rozier ascended, he having the honour of being the first aeronaut. On December 1, 1783, a balloon filled with hydrogen gas took up aeronauts in the persons of MM. Charles and Robert. In 1784 Madame Thible ascended at Lyons before the King of Sweden. She was the first aeronaute. On June 18, 1786, Mr. Festin ascended from Paris, and remained a whole night in the sky. On November 25, 1783, the first ascent in England was made by Count Zambecari, from the Woolwich Artillery ground. He descended at Petworth. On September 21, 1784, the Chevalier Lunardi made the first ascent from London. On January 7, 1785, Mr. Blanchard and Dr. Jeffries, an American physician, ascended at Dover and descended near Calais. After referring to the use of balloons in military operations, the article concluded with the observation that balloons have not justified the expectations they raised.

Death of Edward Turner Bennett

ON August 21, 1836, Edward Turner Bennett, secretary of the Zoological Society, died at the early age of thirty-nine years. Born at Hackney on January 6, 1797, he was trained as a surgeon, and practised for several years near Portman Square. He devoted himself with the greatest ardour to the

study of zoology. He took an active part in forming an entomological society and the Zoological Society. Of the latter he was at first vice-secretary, and from 1831 until his death the secretary. He contributed many papers to the *Transactions of the Zoological Society* and published "The Tower Menagerie" (1829) and the "Gardens and Menagerie of the Zoological Society" (1831). He also prepared an edition of White's "Natural History of Selborne", with numerous notes, which was published after his death. "From the affability of his manners and general scientific and literary attainments," said one writer, "he was highly respected by a numerous circle of friends."

The British Association at Bristol

THE sixth meeting of the British Association took place at Bristol during the week August 22-27, 1936. The proceedings were fully dealt with in the *Athenæum*, which published several double numbers. On Thursday, August 18, the correspondent of the journal wrote: "There is every fair prospect that the meeting will rival that in Dublin, both in the number and the high scientific character of its members. . . . Upwards of 600 new members were enrolled up to Wednesday evening. . . . As far as can be at present foreseen, Geology and Mechanical Science are likely to be the most important Sections. Reports are current that the Rev. Mr. M'Gawley's discovery of the possibility of deriving a motive power from electromagnetism . . . has received a new and important extension which may make sad havoc with steam and railway speculation—but on this subject your readers will soon be able to judge for themselves". Writing again on August 20, the correspondent said that the General Committee had received a letter from the Marquis of Landsdowne expressing his regret that he would not be able to take the chair owing to the illness of his son, and the committee had therefore elected the Marquis of Northampton as vice-president. "It was gratifying," he added, "to observe that all traces of the temporary estrangement of Sir David Brewster from his colleagues on the Council had disappeared".

Societies and Academies

Dublin

Royal Irish Academy, June 22.

C. F. HUMPHRIES and W. E. FROST: The Chironomid fauna of the mosses of the River Liffey. Quantitative samples of mosses were taken from the River Liffey (Ireland) from two contrasting stations; one where the water was acid and one where it was alkaline. The species of Chironomid larvæ found in the mosses were identified; the Orthocladariæ constitute more than ninety per cent of the fauna at both places. The larval Chironomidæ are equally abundant in the acid and alkaline waters, and show only minor qualitative differences. Some notes on the seasonal distribution are given. Four new types are described and figured.

ARTHUR HOLMES: New analyses of Tertiary igneous rocks (Antrim and Staffa). Pending the publication of certain investigations by Dr. F. Allison and the author, it was thought desirable to make available four new analyses of rocks, made in the course of that work. Three of these are from Co. Antrim, namely, rhyolite, Tardree Mountain; olivine-

dolerite, Portrush Sill; and basalt, Giant's Causeway. The fourth is the olivine-basalt of Fingal's Cave, Staffa.

JOSEPH ALGAR: The synthesis of diflavonols. Diflavonols may be synthesized by treating dihydroxy-dichalkones, such as dibenzylidene-diacetoresorcinol, with aqueous alcoholic sodium hydroxide and hydrogen peroxide. In this manner the following have been prepared, with satisfactory yields:—diflavonol; 4'.4"-dimethoxy-diflavonol; 3'.4'-3".4"-tetramethoxy-diflavonol; 3'.4'-3".4"-dimethylene-dioxy-diflavonol. Since dihydroxy-dichalkones are readily obtained from diacetoresorcinol and the suitable aldehyde, the reaction affords a convenient general method for the synthesis of diflavonols.

Brussels

Royal Academy (*Bull. Classe Sci.*, No. 4, 1936).

G. CESÀRO and J. MÉLON: On cryolite. Refractive index, birefringence perpendicular to various faces and crystalline forms.

J. E. VERSCHAFFELT: The thermo-mechanics of the surface layer. (1) Generalities. (2) The adsorption formula. (3) Mixed phases.

E. DE WILDEMAN and E. VERLEYEN: The budding of the epiphyllous tissues in some monocotyledons.

M. DEHALU: Bernstein's theory relating to the hereditary probabilities of blood groups.

L. GODEAUX: Some involutions belonging to the generalized Humbert surface.

P. GÉRARD: The homology between the sense organs of the lateral system and those of the vestibular system in the teleosts.

P. L. CATTALA: Photo-electric recording of the time of passage of stars. Preliminary theoretical study: variation of the luminous flux through a reticulate at the passage of a stellar image.

R. CORDIER: The cutaneous sense organs of *Protopterus*.

G. VAN LERBERGHE and P. GLANSORFF: Contribution to the thermodynamics of open systems.

E. ANGLADE: Flecnodal surfaces of a ruled surface.

L. DERWIDUÉ: Linear congruence of conics.

B. GAMBIER: Study of the cubic surfaces which can possess Eckardt points.

J. L. DESTOUCHES: Role of the notion of stability in physics.

L. MARTIN: Problems of the limits relative to certain systems of partial differential equations.

G. SOKOLOFF: Singular trajectories in the problem of three bodies which attract each other proportionally to their masses and to a function of the distance (2).

M. LECAT: Remark on the note entitled: "The logical foundations of the theory of probabilities", by S. AVSITIDSKY.

JEANNE HENRY-CORNET: Study of the absorption spectrum of bilirubin.

Cracow

Polish Academy of Science and Letters, May 4.

G. GIRAUD: A property of certain generalized logarithmic potentials.

J. WEYSSENHOFF and A. BIELECKI: Quaternions, rotations in space of four dimensions, and the formula of Cayley.

M. MIESOWICZ: The influence of the magnetic field on the viscosity of liquids in the nematic phase. A magnetic field produces a marked increase in the viscosity of *p*-azoxyanisole and *p*-azoxyphenetole in the nematic phase.

B. KAMIENSKI and J. INGLOT: (1) The dielectric potential and surface tension of cholic acid solutions with different concentrations of hydrogen ions. (2) The influence of the hydrogen ion concentration on the dielectric potential of a solution of potassium chloride.

K. SMOLENSKI and W. KOZLOWSKI: The rotatory power of alkaline solutions of saccharose.

MLLE. R. LUDWICZAK and J. SUSZKO: Alloquinidine, a carbinol base derived from quinidine.

J. SUSZKO and M. WDOWICKI: Naphthallymalonic ether and peri-naphthindandiono-carboxylic acid.

K. KONIOR: The profile of the Dziedzice Pleistocene.

M. KSIAZKIEWICZ: The structure of the Lanckorona zone.

M. MEREMINSKI: The development of the embryo-sac in *Begonia incana*. Contribution to the embryology of the genus *Begonia*.

S. MIKULSKI: The influence of alternating temperatures on the development of the eggs of batrachians: *Bufo americanus* and *Ambystoma tigrinum*.

J. ZACWILICHOWSKI: Researches on the innervation and the sensorial organs of the wings of *Isopteryx tripunctata*.

T. GARBOWSKI: The repetition of instinctive acts generally done once only. Remarks on some experiments on *Dicranura* and *Cerura* approaching the chrysalis stage.

June 8.

G. GIRAUD: A generalization of logarithmic potentials of a double layer.

A. JAGIELSKI: The dielectric polarization of the liquid chloronitrobenzenes.

S. DOBINSKI and J. WESOLOWSKI: The density of liquid selenium. The density of selenium between 228° C. and 345° C. is a linear function of the temperature, and shows no sudden variations corresponding to those found by Pélabon in the electrical conductivity of this substance.

A. ZIEMECKI and K. NARKIEWICZ-JODKO: The continuity of the variation of the cosmic radiation in the upper layers of the troposphere. The results of G. A. Suchstorf were not confirmed, and the authors regard it as unlikely that radioactive bodies are present in the higher regions of the atmosphere.

M. KAMIENSKI: Study of the motion of the Wolf I comet.

F. KEPINSKI: The movement of the periodic comet Kopff (1906 e).

K. SMOLENSKI and S. POREJKO: The pH of solutions of lime in water and in solutions of saccharose.

L. MARCHLEWSKI and MLLE. R. GRÜNBAUM: Absorption of ultra-violet radiation by gossypol.

W. GOSLAWSKI: The influence of the hydrogen ion concentration on the dielectric potential and surface tension of solutions of cinchonine and cinchonidine.

J. SZAFIARSKI: Remarks on the thermal properties, transparency and colour of the lakes of the south-west part of the High-Tatra massif.

MLLE. J. DYAKOWSKA: The interglacial period at Ponimiegnie near Grodno.

T. LITYNSKI: The estimation of nucleic phosphorus in the seeds of the bean, *Vicia Faba minor*.

MME. W. ZABLOCKA: The mycorrhiza in the genus *Viola*.

K. ROUPPERT: The leaf of *Philodendron squamiferum*.

J. MAROLSKI and ST. SMRECYNSKI: The Coleoptera of the Pleistocene of Leki Dolne, near Pilzno.

F. ROGOZINSKI and ZB. GLOWCZYNSKI: The behaviour of some liposoluble colouring matters in the animal organism.

Moscow

Academy of Sciences (*C.R.*, 1, No. 8, 1936.)

A. MARKOV: Some theorems on the Abelian entities.

A. DANILEVSKI and M. KREIN: The bilinear developments of symmetrical nuclei, positive in Mercer's sense.

D. MORDUCHAJ-BOLTOVSKOJ: The impossibility of expressing modular functions in a finite form by elementary ones.

I. BESSONOV: The Brownian movement of a linear grid.

I. N. NAZAROV: Splitting and isomerization of olefines indicating a tertiary radical.

M. P. VOLAROVICH, D. M. TOLSTOJ and L. I. KORCHEMKN: A study of the viscosity of molten lavas from Mount Alaghez.

M. NEUHAUS: Frequency of occurrence of spontaneous lethals in mature and immature germ cells of *Drosophila melanogaster*.

Tokyo

Imperial Academy, May 12 (*Proc.*, 5, 109-146).

H. HOMBUR: Theory of affinor transformations.

T. TANNAKA: Existence of a Galois field with a given p group.

T. NAKAYAMA: The algebras over a field with a prime number characteristic (2).

H. KIMURA: (1) Provisional result of the work of the International Latitude Service in the North Parallel + 39° 8' during the year 1935. (2) Preliminary result of the observations made at Adelaide International Latitude Station during the year 1935. (3) Preliminary result of the observations made at La Plata International Latitude Station during the period 1934.64-1935.97.

Y. HAGIHARA: The speed of corpuscles ejected from stellar atmospheres. The speed of ejection of an atom from a star is calculated by a quantum theoretical method which gives Milne's result as a particular case.

T. ARAKI and M. KURIHARA: The relation between the intensity of the emission lines and the displacement towards the violet of the absorption lines in the spectrum of P Cygni. An empirical formula is derived from published results.

S. NISHIKAWA, S. NAKAGAWA and I. SUMOTO: Slowing down of neutrons by thin layers of paraffin.

S. AKABORI and T. KANEKO: A perfume containing sulphur derived from soya.

F. HOMMA: A method of delineating a curve representing the variation of chemical composition in a zoned plagioclase.

K. TANAKA: Remarkable glaciated rocks found in the high mountains of the central upland of Japan.

S. ENDŌ and H. OKUTSU: *Glyptostrobus* cone from the *Liriodendron* bed near Sendai.

H. YABE and M. EGUCHI: *Eohydnophora*, a new genus of Cretaceous corals.

T. SUGIURA: A list of chromosome numbers in angiosperms (2).

Official Publications Received

Great Britain and Ireland

- Forestry Commission. Sixteenth Annual Report of the Forestry Commissioners for the Year ending September 30th, 1935. Pp. 45. (London: H.M. Stationery Office.) 1s. net. [167]
- The National Physical Laboratory. Physical Constants of Pure Metals. Pp. 27. (London: H.M. Stationery Office.) 6d. net. [187]
- University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1935. Pp. 250. (Bristol: The University.) [187]
- The Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1936. Pp. 20. (Ayr: Hannah Dairy Research Institute.) [207]
- Technical College, Bradford. Diploma and Special Day Courses, Session 1936-1937. Pp. 257+22 plates. (Bradford: Technical College.) [217]
- The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 35: Report of the Irish Radium Committee for the Year 1935: including Reports by Oliver Chance and Oswald J. Murphy. Pp. 317-332. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s. [227]
- Bedfordshire 'Vermin' Payments: concerning the Destruction of 'Vermin' by Parish Officials during the XVI-XIX Centuries, with Extracts from their Accounts. By J. Steele Elliott. Pp. 82+2 plates. (Luton: Public Museum.) 4s. [227]
- Technical Publications of the International Tin Research and Development Council. Series A, No. 42: Opacifiers in Wet and Dry Enamels. By Dr. L. Stuckert. Pp. 31. (London: International Tin Research and Development Council.) Free. [227]
- Medical Research Council. Sixteenth Annual Report of the Industrial Health Research Board to 30th June 1936. Pp. ii+34. (London: H.M. Stationery Office.) 9d. net. [237]
- The English Golf Union Year Book, 1936. (Published for the English Golf Union.) Pp. xviii+176+48. (Northwood: Rawlinsons Library.) 2s. 6d. [277]
- Armstrong College, Newcastle upon Tyne: Standing Committee for Research. Report, Session 1934-1935. Pp. 40. (Newcastle: Armstrong College.) [287]
- Home Office. Report of the Advisory Committee on the Scientific Investigation of Crime. Pp. 10. (London: H.M. Stationery Office.) 2d. net. [287]
- International Polar Year, 1932-33: British Expedition to Fort Rae. Some General Characteristics of Aurora at Fort Rae, N.W. Canada, 1932-33. Pp. 6. (London: International Polar Year, c/o Royal Society.) [297]

Other Countries

- U.S. Department of the Interior: Geological Survey. Bulletin 847-C: The Richey-Lambert Coal Field, Richland and Dawson Counties, Montana. By Frank S. Parker. Pp. iv+121-174+plates 22-27. 35 cents. Bulletin 855: Geology and Mineral Resources of the Bellefonte Quadrangle, Pennsylvania. By Charles Butts and Elwood S. Moore. Pp. vi+111+12 plates. 50 cents. Bulletin 865: Geology of the Monument Valley-Navajo Mountain Region, San Juan County, Utah. By Arthur A. Baker. Pp. vi+106+17 plates. 60 cents. Professional Paper 183: Correlation of the Jurassic Formations of parts of Utah, Arizona, New Mexico and Colorado. By A. A. Baker, C. H. Dane and J. B. Reeside, Jr. Pp. v+66+26 plates. 50 cents. Professional Paper 185-H: The Flora of the New Albany Shale. Part 1: *Diachnia kentuckyensis*, a New Representative of the Calamopteryx. By Charles B. Reed. (Shorter Contributions to General Geology, 1934-35.) Pp. ii+149-161+plates 30-33. 5 cents. Water-Supply Paper 677: Ground Water in South-Central Tennessee. By Charles V. Theis. Pp. v+182+7 plates. 50 cents. Water-Supply Paper 679-A: The Thiem Method for determining Permeability of Water-Bearing Materials and its Application to the Determination of Specific Yield; Results of Investigations in the Platte River Valley, Nebraska. By Leland K. Wenzel. (Contributions to the Hydrology of the United States, 1935.) Pp. iv+57+6 plates. 10 cents. Water-Supply Paper 680: Droughts of 1930-34. By John C. Hoyt. Pp. vii+106+1 plate. 20 cents. Water-Supply Paper 760: Surface Water Supply of the United States, 1934. Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. viii+250. 30 cents. Water-Supply Paper 761: Surface Water Supply of the United States, 1934. Part 6: Missouri River Basin. Pp. ix+340. 45 cents. Water-Supply Paper 764: Surface Water Supply of the United States, 1934. Part 9: Colorado River Basin. Pp. vi+151. 20 cents. Water-Supply Paper 773-E: The New York State Flood of July 1935. By Hollister Johnson. (Contributions to the Hydrology of the United States, 1936.) Pp. iv+233-268+plates 22-38. 15 cents. (Washington, D.C.: Government Printing Office.) [157]
- The Tea Research Institute of Ceylon. Bulletin No. 13: Annual Report for the Year 1935. Pp. 85. (Talawakelle: Tea Research Institute of Ceylon.) [167]
- Smithsonian Miscellaneous Collections. Vol. 98, No. 10: Additional Information on the Folsom Complex; Report on the Second Season's Investigations at the Lindenmeier Site in Northern Colorado. By Frank H. H. Roberts, Jr. (Publication 3390.) Pp. iii+38+12 plates. (Washington, D.C.: Smithsonian Institution.) [207]
- Science Reports of the Tokyo Bunrika Daigaku, Series C. Vol. 1, No. 2: Stratigraphical and Palaeontological Studies of the Titibu System of the Kwantô-Mountainland, Part 2: Palaeontology. By Haruyosi Huzimoto. Pp. 29-125+26 plates. (Tokyo: Maruzen Co., Ltd.) 2.60 yen. [207]
- Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 64: Soil Drift in the Arid Pastoral Areas of South Australia. By F. N. Ratcliffe. Pp. 84+12 plates. (Melbourne: Government Printer.) [207]
- Annual Report of the Royal Alfred Observatory for the Year 1935. Pp. 8. (Mauritius: Royal Alfred Observatory.) [217]

Pasteur Institute of India, Kasauli. The Thirty-fourth Annual Report of the Central Committee of the Association and the Audited Account up to March 31st, 1935; also the Report of the Director of the Institute for the Year 1934-35. Parts 1 and 2. Pp. 22+47. (Kasauli: Pasteur Institute of India.) [207]

III^e Congrès International de Pathologie comparée, Athènes, 15-18 Avril 1936. Tome 1: Rapports. 2^{ème} Partie, Section de pathologie végétale: L'Immunité chez les végétaux. Pp. iv+277. (Athènes: Editions "Flamma".) [217]

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 88. Zoological Results of the George Vanderbilt African Expedition of 1934. Part 3: The Fresh Water Fishes. By Henry W. Fowler. Pp. 243-335. (Philadelphia: Academy of Natural Sciences of Philadelphia.) [227]

Proceedings of the United States National Museum. Vol. 83, No. 2984: Polychaetous Annelids from Amoy, China. By Aaron L. Treadwell. Pp. 261-280. Vol. 83, No. 2987: Two New Cottid Fishes from the Western Pacific, with a Revision of the Genus *Stenigis* Jordan and Starks. By Rolf L. Bolln. Pp. 325-334. Vol. 83, No. 2988: Tertiary Plants from Venezuela. By Edward W. Berry. Pp. 335-360. (Washington, D.C.: Government Printing Office.) [227]

The Rockefeller Foundation. Annual Report, 1935. Pp. xv+479. (New York: Rockefeller Foundation.) [227]

League of Nations. The Problem of Nutrition. Vol. 1: Interim Report of the Mixed Committee on the Problem of Nutrition. (Series of League of Nations Publications, II. Economic and Financial, 1936. II. B. 3.) Pp. 98. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 2s. [227]

Memoirs of the Geological Survey of India. Vol. 68, Part 2: The Tertiary Igneous Rocks of the Pakokuk District and the Salingyi Township of the Lower Chindwin District, Burma, with Special Reference to the Determination of the Felspars by the Fedoroff Method. By C. T. Barber. Pp. xii+121-292+xxvi+plates 24-34. (Calcutta: Geological Survey of India.) 4.12 rupees; 8s. [227]

Memoirs of the Geological Survey of India. Vol. 68, Part 1: The Geology of Southeastern Mewar, Rajputana. By Dr. A. M. Heron. Pp. 120+xx+23 plates. (Calcutta: Geological Survey of India.) 7.12 rupees; 13s. [227]

Royal Agricultural Society, Egypt. Bulletin No. 25 of Technical Section and No. 3 of Royal Agricultural Society and Imperial Chemical Industries, Ltd. Joint Agricultural Research Scheme: Experiments in Egypt on the Interaction of Factors in Crop Growth. 3: The Effects of Variety, Spacing, Nitrogen and Water Supply on the Development of the Cotton Plant and the Rate of its Absorption of Nitrogenous Fertilizer. By Dr. Frank Crowther. Pp. 50. (Cairo: Royal Agricultural Society.) [227]

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 99: A Survey of the Pastures of Australia; embodying Ecological Information and Discussions explanatory of the accompanying Pasture Map of the Commonwealth. By Dr. A. McTaggart. Pp. 72+10 plates. Bulletin No. 100 (Radio Research Board Report No. 10): 1: A Directional Recorder for Atmospherics, by W. J. Wark, R. W. Boswell and Dr. H. C. Webster; 2: Observations of Atmospherics with a Narrow Sector Directional Recorder at Canberra, by G. H. Munro, W. J. Wark and A. J. Higgs; 3: Characteristics and Distribution of Sources of Atmospherics, by G. H. Munro, W. J. Wark and A. J. Higgs; 4: Sources of Atmospherics over the Tasman Sea, by R. W. Boswell. Pp. 46. (Melbourne: Government Printer.) [227]

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 11: Tables of Standard Errors of Mendelian Ratios. Compiled by Swarn Singh Purewal and P. Krishna Rao. Pp. ii+37. (Delhi: Manager of Publications.) 12 annas; 1s. 3d. [227]

Ceylon. Part 4: Education, Science and Art (F). Administration Report of the Director of the Colombo Museum for 1935. By A. H. Malpas. Pp. F23. (Colombo: Government Record Office.) 25 cents. [277]

Colony of Mauritius: Department of Agriculture. Sixth Annual Report of the Sugarcane Research Station for the Year 1935. Pp. 52. (Port Louis: Government Printer.) [287]

League of Nations. The Problem of Nutrition. Vol. 2: Report on the Physiological Bases of Nutrition. Drawn up by the Technical Commission of the Health Committee at the Meeting held in London (November 25th-29th, 1935), revised and amplified at the Meeting held in Geneva (June 4th-8th, 1936). (Series of League of Nations Publications, II. Economic and Financial 1936. II. B. 4.) Pp. 27. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 6d. [287]

Bernice P. Bishop Museum. Memoirs, Vol. 12, No. 1: The Physical Characters of the Cook Islanders. By H. L. Shapiro and P. H. Buck (Te Rangī Hiroa). Pp. 35. (Honolulu: Bernice P. Bishop Museum.) [317]

Catalogues

Tanna-Flavine for the Treatment of Burns and Scalds. Pp. 8. Adsorption Indicators. Pp. 32. (London: The British Drug Houses, Ltd.)

Photo-Micrographic Equipment. (Catalog E-21.) Pp. 28. (Rochester, N.Y.: Bausch and Lomb Optical Co.)

A Catalogue of Books, Newsbooks and Pamphlets printed before 1700 relating to Charles I, the Civil War and the Commonwealth, 1625-1660. (No. 524.) Pp. 136. (London: Bernard Quaritch, Ltd.)

Gulf Research in Lubrication. Pp. 20. (Pittsburgh, Pa.: Gulf Oil Corporation.)

The New Hilger Wavelength Spectrometer with a Complete Range of Co-ordinated Accessories forming Spectrometers, Spectrographs, Monochromators and Spectrophotometers for the Visible, Ultra-Violet and Infra-Red. (Publication No. 241.) Pp. 54. Experiments in Spectroscopy: being Courses of Instruction in Practical Spectroscopy for Students of Chemistry and Physics using the Baritt Wavelength Spectrometer and its Accessories. Compiled by Dr. F. Simeon. Pp. 22. (London: Adam Hilger, Ltd.)

G.E.C. Miniature Measuring Instruments. (M.1 Section.) Pp. 40. G.E.C. Industrial Measuring Instruments, Testing Sets, etc. (M.2 Section.) Pp. 88. (London: The General Electric Co., Ltd.)