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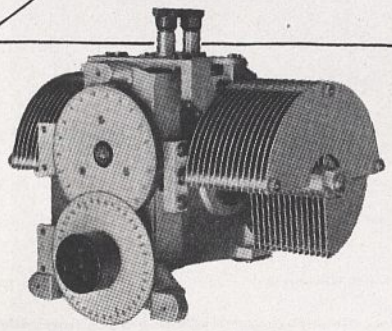

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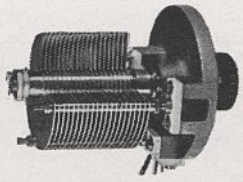

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Vol. 145 SATURDAY, APRIL 6, 1940 No. 3675

INTERNATIONAL UNITY IN WAR AND PEACE

THE solemn declaration of the Supreme War Council issued in London last week states firmly and explicitly what most people have taken for granted about the unity of the Allies in war and in the making of peace. It should now be clear to the whole world that their unity is firmly established, and that it is not merely a contribution towards winning the war but will also constitute the sure and stable foundation of an enduring peace. The two Governments, desiring to extend the scope of agreements concluded last December to all spheres affecting the interests and security of the two nations, mutually undertake that they will neither negotiate nor conclude an armistice or treaty of peace except by mutual agreement, and that they will not discuss peace terms before reaching complete agreement on the conditions necessary to ensure to each of them an effective and lasting guarantee of their security.

The final declaration is even more significant. The two Governments undertake to maintain, after the signing of peace, a community of action in all spheres for so long as may be necessary to safeguard their security, and to effect the reconstruction, with the assistance of other nations, of an international order which will ensure the liberty of peoples, respect for law and the maintenance of peace in Europe. The terms of this declaration are strikingly in harmony with the recent declaration of President Roosevelt, and on that ground alone are reassuring to neutral as well as Allied, opinion and likely to promote Anglo-American understanding and good relations. More important still, confirming Sir John Simon's statement in a recent broadcast that the close Anglo-French co-operation established in every field will continue when the War has ended, it encourages the hopes which have been placed in Anglo-French co-operation as a stepping-stone to a new world order.

The declaration is open to no other interpretation than that the two Governments have accepted the responsibility for a further task when their joint forces have won for them security and the guarantee that it will endure—the organization of a new international order, capable of preserving law, liberty and peace for all nations. Already the co-operation between the two nations in the prosecution of the War itself has led them to give up their absolute sovereignty. That part of their sovereignty which they have surrendered into the common fund of authority is now to remain there at least until the new international order has been established.

This declaration, therefore, amply justifies the hopes of those who saw in the Supreme Council and the Allied High Command the germ from which might develop an international organ of government with an international police force at its command. In the light of it, again, arrangements recently concluded between the British and French Colonial Offices for pooling information and advice on problems of government in Africa may well form the basis for an extension or evolution of the mandates system, which may provide the world with an adequate and just settlement of the problems of colonies and access to raw materials. Similarly, the experience gained in the working of the economic and financial agreements will be of incalculable value.

This declaration justifies the strongest hopes of those who are concerned with the establishment of a new and enduring world order which will safeguard the liberty of peoples and respect for law, on which human progress in whatever field has

been based, and indicates that, when the time comes to discuss larger systems of co-operation, Anglo-French collaboration will provide us with an invaluable store of wisdom on the community of ideas necessary for co-operation to be possible, and on the ends to which co-operation is desirable and possible. Already it shows us that some of the gravest weaknesses of the Treaty of Versailles and of the Covenant of the League of Nations will be avoided. The framework or constitution of the new world order will be attempted by a separate and subsequent act to the framing of the terms of peace. The declaration of March 28 may well come to assume historic significance in the evolution of world order, both as marking a stage towards the renunciation of absolute national sovereignty and in the linking of the distinctive political genius of two entire peoples in building up a system of co-operation to serve their own immediate purposes and also those of all other States subscribing to like ideals of law and justice, of freedom and humanity.

EDUCATION IN THE ARMED FORCES

IN his review in the House of Commons on March 13, the Minister of War directed attention to developments in the provision of educational facilities for men in the Armed Forces. Mr. Stanley outlined the general scheme which is in operation under the ægis of the Central Advisory Council for Adult Education in H.M. Forces (Home Services), which was brought into being a few months ago. The Council is representative of organizations for adult education, and works in conjunction with regional committees set up by the vice-chancellors of universities or principals of university colleges in their own areas. The Board of Education acts as the medium through which the Central Advisory Council makes contact with the Admiralty, War Office, and Air Ministry, while the divisional inspectors of the Board take a similar part with the regional committees. The Central Advisory Council had appealed to the War Office for a sum of £10,000 "to be going on with", and help on a similar scale is being requested from the Admiralty and Air Ministry. The outcome of these applications is not clear and was not dwelt upon by Mr. Stanley in his statement, although the omission suggests that the applications have been at least temporarily shelved. It is essential that the existing situation should be clarified if misconceptions are to be avoided.

At its initial meeting, adequate testimony was reported by the Central Advisory Council to show that men and women in the Services are in pressing need of educational facilities of all kinds, including lectures and discussions, books and correspondence, and other services that have been fostered by adult education associations. The need of men and women in the Services for mental stimulation as well as for welfare and recreational facilities has frequently been neglected, a danger of which full cognizance must be taken to-day. This was not generally realized until the closing stages of the War of 1914–18, and not until 1920 was the Army Educational Corps founded as a permanent organization.

The objects of educational services were stated in an Army Order of September 24, 1918, to be: (*a*) to raise morale by indirectly providing mental stimulus and change, and directly by means of lectures on German methods, guns, etc.; (*b*) to broaden and quicken intelligence both by stimulating a desire for study and by giving men a wider realization of their duties as citizens of the British Empire; (*c*) to help men in their work after the War by practical instruction, so far as may be possible, in their professions or trades. When later the various educational schemes were introduced, they were eminently successful; their earlier introduction might have prevented much of the confusion that followed demobilization. Since that time, adult education has made such great strides that many men and women of the Forces to-day have been accustomed to lectures and discussions. The adoption of adequate educational measures is a matter of urgency, and one which should, if carefully planned, lead to the extension of democratic principles in a way which previously has been impossible.

The types of lectures that are likely to be most popular for men and women in the Forces have already been carefully investigated. The early experiments of the Central Advisory Council showed that the needs of the Services fall into three main groups: (1) a great demand for single lectures by authorities on such subjects as foreign affairs, history, exploration, literature

and economics; (2) a great demand for short courses of about four lectures in places where men are stationed for two months or more; and (3) an appreciable demand for classes in French and German. A scheme worked out by the staff of an evacuated school for men billeted in their area showed that the demands were in many cases more 'practical' than those described above. French and German were asked for by the majority, and next in order of popularity came shorthand and typewriting. Other requests were for mechanics, military geography and building construction. According to a reply from another battalion, contemporary history and current affairs were greatly in demand, while other topics that were repeatedly asked for included first-aid, physiology, psychology, criminology, police law and practice, etc. From the foregoing it may be seen that the provision of *ad hoc* courses would be insufficient and unsuitable for all the varied interests. The facilities provided should coincide with local demands so far as possible. Lecturers on scientific topics would be able to offer their contributions according to the regional demands.

The men in anti-aircraft and coastal defence units deserve particular attention. Many of them are desperately in need of educational facilities to relieve their long hours of monotony. It is heartening to find in Mr. Stanley's statement that for these units a more ambitious scheme involving continuous forms of education is under consideration. An official of experience in adult education is being seconded from the Board of Education and, in association with a military representative and an experienced welfare worker, is to prepare a scheme whereby educational and recreational facilities are to be developed side by side.

Considerable evidence is available to indicate the great importance of adequate library facilities to ensure the success of such a scheme, while the use of itinerant and peripatetic tutors would do much to encourage studies under adverse conditions.

The responsibilities devolving upon scientific workers to collaborate in any prepared schemes of continuous education would, if possible, be even greater than in peace-time. Astronomy, meteorology, horticulture and agriculture are subjects that have frequently been asked for by men in these isolated units, while other sciences would undoubtedly be in demand.

The supply of teaching personnel to satisfy these varying demands should not present any considerable difficulty; lecturers and tutors of all types would be more than ready to take an active part in any schemes of education that are prepared. The staffs of universities and university colleges have already expressed their willingness to contribute to the general scheme. It is to be expected that others who are interested in adult education would be available. A plea should also be made that the young school teachers who are already serving in the Forces should be made use of. Many of these teachers who have been conscripted would be glad to avail themselves of opportunities for getting practice in teaching; their adaptation to the elastic conditions that must inevitably arise should do much to increase their efficiency on their return to civil life.

Education in the Armed Forces is unquestionably a subject that is fraught with considerable difficulties. The one aim that should be constantly before our eyes is to discover the shortest method of bringing the War to a successful conclusion, and it is clearly recognized that in no circumstances must anything be allowed to interfere with military training or efficiency. But the contribution that mental alertness can make to military efficiency must also be fully grasped; its value to the peace and after is paramount. It is time, therefore, that the provisions made for educational services should be clearly stated, and a clear-cut policy adopted. To that end it is important that the schemes proposed by the Central Advisory Council should be carefully scrutinized. It is doubtful whether these schemes can be fully implemented until control is given to someone possessing the position, authority and drive enjoyed by Lord Gorell at the end of the War of 1914–18 in his capacity as head of the Army Educational Corps.

The establishment of a strong central organization would provide means whereby negotiations could be carried out with academic and professional bodies for the due recognition of the educational work done by men and women in the Forces. It could also arrange for the collection and distribution of books, films and equipment, etc. This central body would be able to co-ordinate the activities of the Central Advisory Council and the regional committees by the appointment of education officers in each battalion. The appointment of education officers would carry numerous advantages. They would be able to provide relevant information about the kind of educational services required in their particular units; they

could give individual attention to all the educational problems confronting men drawn from primary and secondary schools, training colleges and universities. Thirdly, they would accompany their battalions when transferred from one district to another in Britain, and perhaps overseas.

It is important that educational facilities should not be limited to men and women in Great Britain. The extreme value of educational services in helping thousands of wounded soldiers towards recovery was strongly indicated by the Director-General of Army Medical Services in 1914–18. The acceleration of recovery through the awakening of mental interest should be a commendable feature at the present time. There has already been a steady demand overseas for lessons in the French language, the provision of which has performed useful service in consolidating Anglo-French relations. The success achieved by the introduction of these classes should be sufficient encouragement for the development and extension of educational services overseas.

ASPECTS OF THEORETICAL PHYSICS

(1) Lehrbuch der theoretischen Physik
Von Prof. Dr. Georg Joos. Dritte Auflage. Pp. xviii + 704. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 24 gold marks.

(2) Lectures on Quantum Mechanics
By Prof. M. Raziuddin Siddiqi. Vol. 1. Pp. xi + 293. (Hyderabad: Osmania University, 1938.) 6 rupees; 8*s*. 6*d*. net.

(3) Atombau und Spektrallinien
Von Prof. Arnold Sommerfeld. Band 2. Zweite umgearbeitete und erweiterte Auflage des "Wellenmechanischen Ergänzungsbandes". Pp. xi + 820. (Braunschweig: Friedr. Vieweg und Sohn, 1939.) 35 gold marks.

(4) La Chimie Mathématique
Vol. 1: Théorie Nouvelle de la Mécanique Statistique. Par Prof. Th. De Donder. Pp. 83. (Paris: Gauthier-Villars et Cie., 1938.) 40 francs.

(5) Hand- und Jahrbuch der chemischen Physik
Herausgegeben von A. Eucken und K. L. Wolf. Band 3, Teil 2, Abschnitt 3–4: Die Boltzmannsche Statistik und ihre Modifikation durch die Quantentheorie, von A. Sommerfeld und L. Waldmann; Freie Weglänge und Transporterscheinungen in Gasen, von Karl F. Herzfeld. Pp. x + 276. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 28.80 gold marks.

IF mathematical physics can justly be considered as the prototype of international science, as a language understandable to all, independent of nation and race, the present volumes not only testify to this fact, but also at the same time to the opposite statement: that differences of personality are inextinguishable and apparent even in the presentation of the most objective of sciences.

The first two books are text-books intended for the use of teachers and students. (1) Joos' work is a remarkable attempt to compress the whole of mathematical physics, up to the most modern branches, into one single volume. The success of this attempt (in Germany) is proved by the fact that three editions have been published in a few (seven) years. I have read sections of all chapters, starting with the excellent introduction on mathematical methods of physics, passing over classical mechanics, relativity, electrodynamics, thermodynamics, to the modern parts which deal with statistical mechanics, structure of atoms and molecules, quantum and wave mechanics, and ending with nuclear physics—and everything is equally well presented, clear, short and interesting. It is an admirable book, which can be warmly recommended to all who can read German fluently. Numerous examples, the solutions of which are contained in an appendix, will be very useful for the beginner.

(2) The second volume, by Siddiqi, published in Hyderabad, India, is of about the same apparent size, but covers only a narrow field, quantum mechanics. The size is in fact deceptive as the number of pages, 287, is very much smaller than that of Joos' book, 704, and the print more open; the weight of the two volumes is in the ratio 1 : 2. I should have liked to praise this book also very highly, but I have to refrain as I could not help recognizing too many features of my own lectures in Siddiqi's work. In fact, the author was among my students in Göttingen and went later to Leipzig, where he attended Heisenberg's lectures. Since Heisenberg and I had only just parted after some years of collaboration when he was my assistant, there is little wonder that his lectures were rather similar to my own.

This origin of Siddiqi's book, which can be traced even to details of notation, is partly revealed by the author as he has dedicated it to Heisenberg. There are, of course, some new sections, short references to the neutron and

positron which were discovered more recently, to nuclear physics, and an outline of Dirac's theory of the electron. But as a whole, it is exactly the kind of presentation I would myself give if I ever have time enough to publish my lectures. Therefore I must frankly declare it a very good book, as regards selection of subjects, mathematical treatment, physical interpretation. As one example I wish to mention the derivation of the uncertainty principle, expressed by the formula $\triangle p . \triangle q \geqslant h/4\pi$, as given by Siddiqi in §10.6, in comparison, for example, with Sommerfeld's treatment in iii, §6, of his book (reviewed below); both are, of course, based on a well-known paper of Schrödinger (*Preuss. Akad.*, 1936), but the form of the proof given by Siddiqi, which uses the operator calculus, seems to me preferable because of its clearness. (This proof is also published in an appendix of my book "Atomic Physics".)

(3) The most important work among these five volumes is that of Sommerfeld, which reveals in every line the strong scientific personality of its author. The original work, now vol. 1 of the whole, appeared just before the discovery of wave mechanics, and Sommerfeld wrote his "Ergänzungsband" after this event as a short appendix to the main volume. But it soon became evident that this did not do justice to the importance of the new theory. Twelve years passed before Sommerfeld published this second volume, twelve years of incessant labour and continual improvement. The book has become a masterpiece indeed. The style is of the same simplicity and clearness as that of the original volume. The reader will never be puzzled by remarks like "it can easily be shown that . . ." which, in other books, indicate the presence of a particularly intricate difficulty and cost the serious student more time than the rest of the book.

Sommerfeld's work is a kind of codification of a considerable part of quantum mechanics, collecting results scattered over the literature of all nations and uniting them into a structure of great beauty. There are a great many sections containing Sommerfeld's original work, and that of his pupils. An important feature seems to me the careful derivation of normalization factors of eigen-functions, not only for discrete energy levels, but also for the continuous spectrum. These are used in a thorough study of the photo-electric effect (Chap. vi) and continuous X-ray spectra (Chap. vii). Where other books stop short because of increasing analytical complications, Sommerfeld just starts full swing, and it does not look any more involved. The Dirac electron is introduced at an early stage (Chap. iv) and used whenever spin effects are important. The treatment of the spin is a particularly fascinating feature; Sommerfeld does not use the spinor calculus generally adopted, in which the operators are 4×4 matrices with respect to the spin variable, but represents the spin properties with the help of a non-commutative algebra of sixteen units, which are formed by all independent products of four anti-commuting quantities γ_1, γ_2, γ_3, γ_4. His method of reduction of spin equations to ordinary equations, with help of null divisors (*Nullteiler*), is very powerful and simpler than the usual matrix calculus; and the relativity invariance of the equations can be shown in a most direct fashion. It is very interesting that this point of view has been recently adopted in a paper by N. Kemmer on meson theory (see *Proc. Roy. Soc.*, Nov. 1939), in which he shows that the particle aspect is better expressed by an abstract algebra, the wave aspect by a special matrix representation, both in the case of the electron and in that of the meson.

At the end of Sommerfeld's book there are several appendixes of a more mathematical character. For although the book itself contains formidable mathematics enough, it must be stressed that there is no sentence in which the physical idea is neglected or forgotten. It is a book on physics—mathematical physics, if you like—but not on 'applied' mathematics. But it demonstrates the great power of the mathematical method in describing natural laws. There is no other work which gives so full an account of the victorious path of modern theory. I hope that an English edition will be published.

(4) The next book of the collection is of the very opposite character. De Donder's new statistical mechanics is rather mathematical and formal. It can be read only by those who have a fair knowledge of the subject from other sources. The uninitiated reader would stumble over definitions the meaning of which must appear mysterious, and wonder about theorems stating results of no evident physical importance. I am myself not mathematically minded enough to appreciate the finesses of the procedure. So far as I understand it, the idea is to define all observable averages of a statistical ensemble by two kinds of derivatives, one with respect to phase volume (in the sense of Gibbs's micro-canonical ensemble), and one with respect to the number of particles (treated as a continuous variable). It is then possible to avoid all further references to ordinary counting and averaging, and to proceed quite formally.

I must confess that I was not able to follow the abstract argument. If, for example, the Bose and the Fermi statistics are derived from a general formula containing a quantity $\triangle\omega'$ (being apparently a finite increase of phase volume), by equating this $\triangle\omega'$ to $+1$ or -1 ("Faisons $\triangle\omega' = -1$; nous obtenons la loi de repartition qui

caractérise la mécanique statistique de Fermi"), I feel uncomfortable and should like to ask why we are doing so. This non-physical attitude is characteristic of this book; but mathematicians may enjoy De Donder's rigorous treatment.

(5) The last volume brings us back to normal physics. It contains two articles treating statistical thermodynamics of gases, the first one in the case of equilibrium, the second one for stationary processes. Both are readable and in general up to date. The article of Sommerfeld and Waldmann gives a good account of classical and quantum statistics; it leads up to the condensation phenomenon due to van der Waals' forces, which are treated much in the traditional way, as the article was apparently sent to press a short time before the new powerful method of J. E. Mayer (*J. Chem. Phys.*, **5**, 67, 74, 1937) was published. Herzfeld's article contains not only the usual considerations about transport phenomena in gases, but discusses also molecular rays, the modern methods of Chapman and Enskog, Knudsen's investigations of rarified gases, and many other questions.

MAX BORN.

FRUIT PRODUCTION AND PRESERVATION

(1) The Fundamentals of Fruit Production
By Prof. Victor Ray Gardner, Frederick Charles Bradford and Henry Daggett Hooker, Jr. (McGraw-Hill Publications in the Agricultural Sciences.) Second edition. Pp. xvi+788. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 30*s*.

(2) Commercial Fruit and Vegetable Products
A Textbook for Student, Investigator and Manufacturer. By Prof. W. V. Cruess. (McGraw-Hill Publications in the Agricultural Sciences.) Second edition. Pp. x+798. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 36*s*.

FOOD production and preservation are subjects which concern everyone to-day. To its furtherance science has contributed from all their fields, and no side of food production has benefited more from scientific research than that of pomology. Every stage of production from the propagation of the young tree and the breeding and selection of new varieties to the marketing of the fresh fruit or the preserved article has received intensive study. A subject so wide is difficult to present in its entirety even in two volumes as large as those under review, and any authors attempting the task of collating and condensing the mass of literature must almost inevitably omit much which to other workers will seem of prime importance.

Taken together, these two books provide an almost complete encyclopædia of the application of science to fruit production, omitting only, in the case of the first book, the aspect of pest and disease control. Both are alike in that they approach their subject from the scientific point of view rather than the empirical and practical. In the first, cultural practices are considered only in so far as they modify the relation of the plant to the complex of the environment, and it is this latter which receives first attention. In the second, while manufacturing technique is the dominating theme, the dependence of the technical processes on fundamental principles and the results of research is stressed throughout.

Unfortunately, to the student in Great Britain, both suffer from the same defect, the failure to present adequately the contributions of research workers in this country. In this respect the book by Prof. Gardner and his co-workers is open to the greater criticism. It is surprising, for example, to find no mention, in the otherwise admirable account of the seasonal changes in carbohydrates and nitrogenous substances in the apple tree, of the now classic series of investigations by Smyth, Karmarkar, Kench and others at Long Ashton Research Station. Again, a discussion of the root systems of fruit trees is very incomplete without reference to the work of Rogers at East Malling. Many other such instances might be given.

The book is divided into seven sections, dealing respectively with water relations, nutrition, temperature relations, pruning, fruit setting, propagation, and geographical influences on fruit production. The authors freely admit that comparatively little that is original is presented; their aim has rather been to survey the field of research and show how the results of scientific investigation may be applied to the problems of practical growing. It is, however, to be regretted that this second edition of a book so well known should have been prepared almost entirely by additions to the old text rather than by a thorough rewriting. In some sections this is of no consequence, as recent work has only enlarged or extended previous knowledge. The sections on pruning and propagation, however, lose greatly by the failure of the authors to re-orientate the outlook in the light of the new hormone concept of plant growth and regeneration. The revolution which this

concept has brought about in physiological ideas is so great that lack of any mention is a serious omission. Nevertheless, students of pomology owe a debt of gratitude to the authors for collating so much material from the original sources and presenting it in a digested and readable form.

Prof. Cruess takes up the story at the point where the other authors leave it. His book is an exhaustive survey of the principles and practice of fruit and vegetable preservation from the commercial point of view. It is designed as a university or college text-book for courses in food technology, but will be of equal value to the scientifically minded manufacturer. As would be expected in an American book, chief attention is given to the technique of canning, which occupies about one third of the whole volume, but every product manufactured from fruit and vegetables receives adequate consideration, from dried fruits to pickles and wines. For the English student insufficient discussion is given to the manufacture of cider and perry, but this is easily understandable in a book written for American conditions where these products are of very minor importance.

Three useful and interesting chapters at the end deal with vitamins, plant pigments and the enzymes of fruit and vegetables. Prof. Cruess follows the latest American practice in re-naming vitamin B_2, vitamin G, and preserves a nice neutrality on the controversy concerning its identity with lactoflavine. The treatment of the anthocyanins is somewhat cursory in view of their importance in the appearance of canned and other products, and some review of the work of Scott-Moncreiff on the chemistry of these compounds would have added interest. The book is, however, not intended as a biochemical treatise, and it succeeds admirably in its main function of reviewing the most modern technique in food preservation.

R. H. STOUGHTON.

HUYGENS' PRINCIPLE

The Mathematical Theory of Huygens' Principle
By Prof. Bevan B. Baker and Prof. E. T. Copson. Pp. vii+156. (Oxford : Clarendon Press ; London : Oxford University Press, 1939.) 12*s*. 6*d*. net.

THERE are several parts of the science of physics which appear very simple when expounded briefly in elementary text-books, but nevertheless present great difficulties when examined more carefully. A good example of this is furnished by Huygens' principle, which in its original form discusses the propagation of light by asserting that the wave front is the envelope of secondary waves whose centres are themselves on a previous wave front. The first difficulty in this elegant geometrical construction is that it gives not only the actual wave propagated forwards, but also another propagated backwards, which does not really exist. To the simple principle Huygens therefore added the special assumption that only one sheet of the envelope, namely that propagated forwards, was to be considered. The next difficulty is to explain diffraction. To do so, Fresnel replaced Huygens' isolated spherical waves by purely periodic trains of spherical waves, and made use of the principle of interference. He had to restrict his treatment to the case of small wave-lengths, and also had to make two additional assumptions concerning the relations of the amplitudes and phases of the secondary waves to those of the primary. The necessity for these two additional assumptions, which appear to be of an arbitrary character, has led some to consider Fresnel's theory as merely a convenient device for calculation without any sound physical basis. In any case, the principle so far takes no account of the phenomenon of polarization, although this was discovered by Huygens himself. In fact we may say that what was put forward as a theory of optics cannot, in anything like its original form, be legitimately applied to that branch of physics, though it may apply to acoustics. The necessity for a careful re-examination of the subject is now apparent. Unfortunately, this seems possible only on an analytical basis, with rather complicated mathematics ; the elementary geometrical treatment appears to fail to give the results required, unless it is supplemented by special assumptions.

This re-examination of Huygens' principle was part of a much larger programme, covering the whole field of the partial differential equations of mathematical physics, which was the subject of a course of lectures by Prof. E. T. Whittaker sixteen years ago, and was to have been treated in a comprehensive text-book by his pupil, now Prof. B. B. Baker. Unfortunately, ill-health and pressure of other duties intervened, and Prof. Baker, in collaboration with Prof. E. T. Copson, intends to replace the projected treatise by a series of monographs, of which this is the first. The reader is assumed to have a knowledge of pure and applied mathematics roughly equal to what is possessed by an honours student of mathematics who has completed the compulsory parts of his degree course, and is about to enter upon some specialized study. The book deals with the subject in connexion with the general theory of

the solutions of the partial differential equations involved, with some of the simpler diffraction problems as examples illustrating that theory.

The book contains four chapters. The first deals with Huygens' principle in what may be called its acoustical form. The theorems of Poisson and Helmholtz are given, but are shown to be included in that of Kirchhoff, which is the proper analytical formulation of the 'acoustical' principle. The two-dimensional analogue is due to Volterra. Marcel Riesz treated the case of cylindrical waves in an elegant manner, using the theory of the analytical continuation of a function of a complex variable.

The second chapter gives Kirchhoff's theory of diffraction, and the criticisms of it by Poincaré and Kottler. This theory, in addition to being difficult to apply to special problems, seems to involve conditions not intended by its author.

The third chapter takes account of polarization, and gives the three methods due to Kirchhoff, Larmor-Tedone, and Kottler. It is shown that the first and second fail, but the third appears to have overcome the difficulty of defining "blackness".

The fourth chapter gives Sommerfeld's and Voigt's methods of solving certain diffraction problems, chiefly two-dimensional, such as diffraction by a half-plane. These give results agreeing fairly well with experiment, but a rigorous theory, taking into account the properties of the material of the screen, is still lacking.

It is unfortunate that the book did not appear about the time of the original lectures. At present mathematical physicists are busy with the rapid developments of modern physics, and older problems are likely to be neglected.

H. T. H. PIAGGIO.

ENZYMES FROM MANY ASPECTS

Ergebnisse der Enzymforschung

Herausgegeben von F. F. Nord und R. Weidenhagen. Band 8. Pp. x+324. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 28 gold marks.

THE early volumes of this annual compilation dealt with the individual enzymes, their properties and mode of action: attention is now turning to the role of enzymes in normal and pathological metabolism.

The opening article by R. W. G. Wyckoff of Pearl River, New York, deals with the subject of purified viruses, those agents of transmissible disease which are smaller than demonstrable micro-organisms. In connexion with them the question has been raised whether they are living agents or a transitional form intermediate between animate and inanimate matter. Their study may be an approach to the meaning of the term 'alive'.

The experimental problem is to get them in concentrated and purified form. More than one hundred virus diseases are now known, each with its characteristic causative agent in which a protein carries the virus. The proteins are large aggregates, and we are beginning to find out something about their size and shape by the application of a number of ingenious physical methods.

Attention is further being turned to the discovery of macromolecules in healthy tissues; several have been found in plants—they are pigmented, sediment at about the same rate, and may be macromolecular chlorophylls. They are smaller than the smallest virus proteins.

The mechanism of a still very obscure reaction, that of symbiotic nitrogen fixation, is discussed by P. W. Wilson of Madison, Wisconsin. A forty-page summary emphasizes that what is now required are experimental data rather than interpretations: the difficulty is to devise crucial experiments.

Each enzyme has in the laboratory an optimum *p*H concentration for maximum activity, but it is uncertain whether the same applies to its behaviour in the tissues. H. J. Vonk of Utrecht discusses this subject in relation to the digestive enzymes. As the various enzymes have different *p*H optima, the concentration in the intestine cannot be the best for any one of them but must be a compromise suitable more or less to all.

Enzymes are beginning to be sought for as an aid to clinical diagnosis. A rather lengthy essay by R. Ammon and E. Chytrek of Breslau summarizes present knowledge.

R. J. Dubos of New York describes the enzymatic analysis of the antigenic structure of pneumococci. It is known that the capsular polysaccharides of the different types are of paramount importance in conditioning the serological specificity and virulence of these organisms. When virulent pneumococci are treated with enzymes which destroy their capsule, they lose also the property to agglutinate in specific antiserum.

There are in all eleven articles, but enough has been said to indicate the variety of subject. The contributions are, as usual, international in source, and it is interesting to note two from Indian laboratories, though the work of Miss Scott Moncrieff was done at Cambridge. E. F. A.

THE DRIFT OF THE ICE-BREAKER *SEDOV*

By Prof. N. N. Zubov

ATTEMPTS have been made by many expeditions to penetrate to the central part of the Arctic Ocean. A few have even succeeded in reaching the North Pole itself. After several unsuccessful attempts, the American explorer Robert Peary, on April 6, 1909, reached the North Pole on sledges drawn by dogs and remained there for some thirty hours. On May 9, 1926, the American aviator, Admiral Richard Byrd, flew to the Pole by aeroplane and describing a circle in the air, returned safely to Spitsbergen, the starting point of the flight. In the same year, the Norwegian explorer Amundsen crossed the Arctic Ocean from Spitsbergen to Alaska in a dirigible, flying over the North Pole on May 12. On May 24, 1928, the Italian expedition of General Nobile also succeeded in reaching the North Pole in a dirigible, which circled over it; but the expedition met with disaster on the return flight and some of the members perished.

Concerted attempts to reach the North Pole were made by Soviet explorers in 1937, in which year nine Soviet aeroplanes flew over the Pole. While the North Polar Station on the drifting icefloe was being set up, there were present at the Pole four heavy aeroplanes and thirty-three Soviet polar explorers. During those days five aeroplanes, piloted by Molokov, Golovin, Vodopianov, Alexeyev and Mazuruk, flew over the Pole. On June 18, 1937, Chkalov's machine passed over the Pole on his flight from Moscow to the United States. On July 13, 1937—following the same route—Gromov flew his machine over the North Pole; on August 13, Levanevsky flew over the North Pole on his way to America. Levanevsky was afterwards lost and during the search for his machine, Vodopianov flew over the Pole on October 7, 1937, and Moshkovsky on April 4, 1938.

Forerunners of the *Sedov*

Only three expeditions have drifted with the ice in the Arctic: Nansen's expedition of 1893–96 on the *Fram*, Papanin's North Polar expedition on the drifting icefloe of 1937–38, and the expedition of the Soviet polar explorers on the ice-breaker *Sedov* (NATURE, **143**, 837; 1939).

Nansen's expedition did not reach the North Pole. During her drift the *Fram* only reached lat. 85° 56′ N. Yet it was Nansen who, in a scientific sense, literally discovered the Arctic Ocean. Prior to the drift of the *Fram* very little indeed was known about this ocean. Nansen himself did not expect to find depths exceeding 500 m. (1,640 ft.) and consequently did not take with him the necessary equipment for sounding great depths.

From Nansen's expedition it was learned that the Arctic Ocean was a sea having depths of more than 3,000 m. (9,843 ft.). The warm Atlantic waters—a branch of the Gulf Stream—were shown to penetrate as a deep current far into the central part of the Arctic Ocean. Nansen's observations revealed the primary conditions of the movement of the ice in this basin. Lastly, Nansen also studied the principal conditions governing the formation, development and disintegration of sea ice. There is not an aspect of oceanography and geophysics relating to the Arctic Ocean to which Nansen's expedition did not make important discoveries.

On May 21, 1937, with the help of four heavy aeroplanes, the Pananin expedition was landed on the ice. On a big icefield the Soviet polar explorers set up a well-equipped polar observatory. On June 6 the organization of the North Polar Station was completed. The aeroplanes flew back to the mainland, leaving Papanin, Krenkel, Shirshov and Fedorov on the ice. They remained on the icefloe for 274 days. During this period the icefield of the Papanin expedition was carried from the North Pole to the east coast of Greenland where, at lat. 70° 54′ N. and long. 19° 48′ W., the drifting expedition was taken off by the ice-breakers *Taimyr* and *Murman*.

The men of the expedition on the drifting icefloe measured all depths along the entire course of their drift from the North Pole to the coast of Greenland. They revealed the movement of the ice and sea current under the ice which had escaped Nansen's attention. They refuted Nansen's theory that no life existed in the central part of the Arctic Ocean. They carried out valuable observations on terrestrial magnetism. The meteorological observations of the Papanin expedition not only facilitated the organization of the trans-Arctic flights of Chkalov and Gromov, but also contributed to our knowledge of the structure of the atmosphere and the processes determining the weather in the central part of the Arctic.

START OF THE *Sedov* DRIFT

Contrary to the drifts of the *Fram* and the North Polar Expedition on the drifting icefloe, the drift of the *Sedov* was not deliberately planned. With the ice-breakers *Sadko* and *Malygin*, on October 23, 1937, the *Sedov* was caught in the ice in the Laptev Sea at lat. 75° 19′ N. and long. 132° 25′ E. On August 28, 1938, these ice-breakers were at lat. 83° 06′ N., long. 138° 24′ E. On that day the ice-breaker *Yermak* extricated the *Sadko* and *Malygin* from the ice and brought them into clear water. The *Sedov*, however, could not be released owing to the fact that during her imprisonment in the ice she had sustained some damage to her steering gear.

Fifteen volunteers, headed by Captain Badygin, remained on the *Sedov*; and from that time the vessel continued her remarkable drift in the most inaccessible part of the Arctic Ocean, where no other vessel had ever drifted before and no aeroplane had flown.

Several circumstances make the drift of the *Sedov* of exceptional interest. First, the drift of the ice-breaker began at a time when the North Polar Expedition on the drifting icefloe was still making observations. Thus, uninterrupted observations of the central parts of the Arctic Ocean were being conducted. Secondly, soon after the commencement of the drift of the *Sedov* and also in the Laptev Sea but in the south-western part, there began the drift of several vessels headed by the ice-breaker *Lenin*. These vessels had been carried from Khatanga Bay. The drift of the ice-breaker *Lenin* ended on August 7, 1938, when, with the entire caravan of ships, she was extricated from the ice by the *Krassin*. Thus, for nine months two caravans of ships drifted simultaneously at some distance from each other, one in the south-western part of the Laptev Sea, the other in the north-eastern part of the same sea, and in the region to the north of the New Siberian Islands.

A comparison of these drifts has yielded noteworthy results. Differing from each other in details, these drifts at the same time reveal extraordinary similarity, a fact which goes to show that they were conditioned by the same causes: the prevailing winds and constant currents.

Thirdly, soon after the commencement of her drift, the *Sedov* found herself in the region where the drift of Nansen's *Fram* started.

A comparison of the subsequent courses of the drifts of the *Fram* and the *Sedov* is of exceptional interest, because the former took place in climatic conditions differing considerably from those of the present day. At first the *Sedov* drifted directly northwards. In a month, under the influence of west winds the ice-breaker turned eastwards, and early in January, 1938, reached the most easterly point of her course—lat. 78° 25′ N. and long. 153° 26′ E. From that time the *Sedov* began slowly to move westwards, at the same time going more and more to the north. She continued this north-westerly direction, and on March 22, 1939, reached lat. 86° 34·7′ N. and long. 108° 50′ E. Later, the drift began gradually to incline to the south-west. From May 17 until July 27, 1939, the courses of the *Sedov* and the *Fram* overlap, as it were, but afterwards the *Sedov* again commenced to go rapidly to the north, and on August 29, 1939, reached the northernmost point of her drift, lat. 86° 39·5′ N., long. 47° 55′ E. After that the *Sedov* again descended to the south, crossing the *Fram's* course, and along a line lying between the drifts of the expedition on the drifting icefloe and that of the *Fram*, made for the broad strait dividing Greenland from Spitsbergen. From December 1, 1939, the *Sedov* was finally drawn into the drift of the ice moving from the Arctic Basin to the Greenland Sea; with gradually increasing speed the ice-breaker drifted almost due south. On January 1, 1940, she had already reached lat. 81° 15·4′ N., long. 4° 16′ E. She was afterwards extricated from the ice by the ice-breaker, *Joseph Stalin*. Her crew was taken off the vessel on January 13, and on January 29, 1940, the *Sedov* arrived in Murmansk.

END OF A LEGEND

One achievement of the *Sedov* is the final explosion of the Sannikov Land legend. In 1811 Jacob Sannikov purported to have sighted from the northern coast of Kotelny Island a high land which he attempted to reach by crossing the ice; he was prevented from doing so by a big polynia (an expanse of clear water in the icefield). According to Sannikov, there remained only another 25 kilometres (15½ miles) for him to cross in order to reach this land. Doubts as to the existence of this supposed land have, however, been held by many for several decades.

The *Sedov*, during the period of her drift, twice crossed the region of the supposed land: once from west to east, approximately at the 78th parallel, and the second time from the south-east to the north-west. Later, the air expedition of Alexeyev passed over the region approximately in a meridianal direction. The flights were from the northern extremity of Kotelny Island to the drifting caravan of vessels, the *Sadko*, *Sedov* and *Malygin*, and were made at a time when visibility was excellent.

Through this same region also passed the ice-breakers *Yermak* and *Joseph Stalin* on their way to meet the drifting vessels. Yet neither ice-breaker saw any sign of 'Sannikov Land'.

Boundary of the Laptev Sea

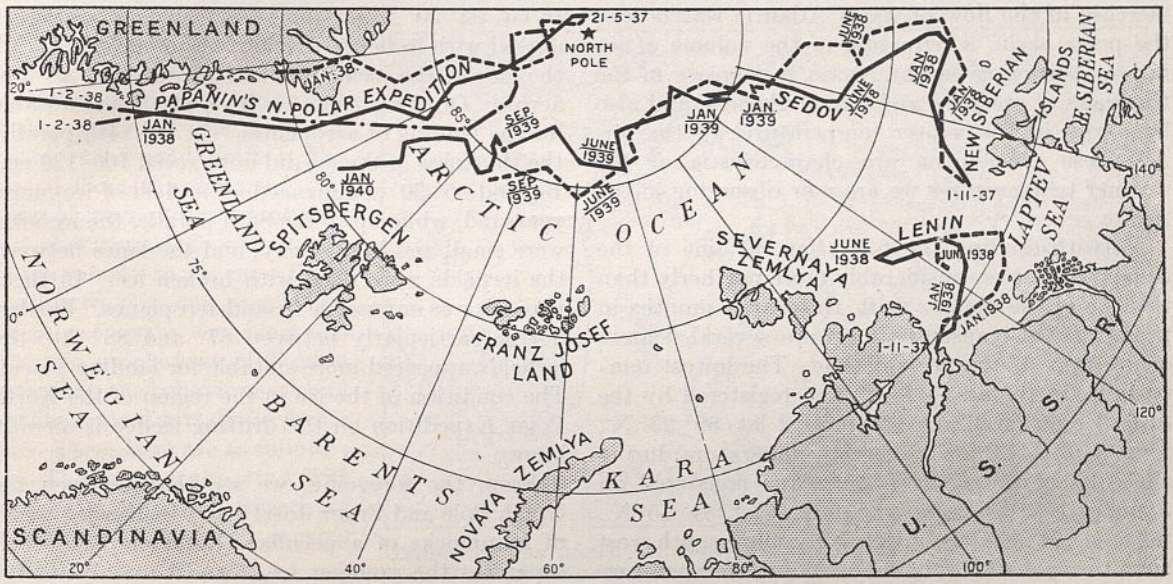
From the point of view of physical geography, the Laptev Sea is not a sea but only a gulf of the Arctic Ocean. The northern boundary of this sea is conditional, having been fixed by the Soviet Government as the arc of the great circle connecting Cape Molotov (the northern point of Severnaya Zemlya) with the point at which the meridian crosses the northern point of Kotalny Island (long. 139° E.) and the edge of the continental shelf. The drift of the *Sedov* from the beginning up to lat. 79° 37′ N., long. 149° 58′ E. proceeded along the continental shelf. The depths did not exceed 200 m. However, at lat. 79° 52′ N., long. 148° 02′ E., the *Sedov* found herself over depths considerably exceeding 3,000 m., that is, at depths characteristic of the deep bed of the central part of the Arctic Ocean.

The region lying to the north of the New Siberian Islands has been thoroughly sounded. From a comparison of these soundings, it appears most probable that the continental shelf at the Kotelny Island meridian (long. 139° E.) ends at lat. 78° 30′ N. This must be considered as the north-eastern point of the Laptev Sea.

As was found in the region of the New Siberian Islands, the continental shelf stretches farther north than was supposed, and the continental slope is much more gradual. It occupies 2° of latitude and has a gradient of not more than 1.

To the north of Franz Josef Land great depths were unexpectedly discovered. At lat. 86° 26·6′ N., and long. 39° 25′ E. the expedition failed to find bottom at 5,180 m.

Extremely interesting are the soundings obtained by the *Sedov* in the latter stages of her drift—at the entrance to the Greenland Sea. Nansen surmised that between the north-eastern extremity of Greenland and the north-western extremity of Spitsbergen was a submarine ridge separating the great depths of the Arctic Ocean from the great depths of the Greenland Sea. This ridge came to be known as Nansen's submarine ridge. Its eastern part was studied in 1935 by the *Sadko* expedition, and the western part by the Papanin North Polar Expedition on the drifting icefloe. The *Sedov* crossed Nansen's submarine ridge in its middle part, at lat. 81° 34′ N., long. 4° 40′ E., and registered a depth of 1,500 m., thus confirming the existence of this ridge.



The Russian Drifts.

——— actual drift, - - - - - - theoretical drift without account of constant currents, —·—·— theoretical drift with account of constant currents.

Changes in the Thermal Balance

In addition to the sounding of depths, the *Sedov* crew carried out meteorological, hydrological, magnetic and gravimetrical observations along the same lines as the members of the North Polar Expedition on the drifting icefloe. The observations of the *Sedov* crew confirmed what has already been recorded by the Papanin expedition and by Nansen : on the whole course of their drift they discovered at intermediate depths warm waters of Atlantic origin.

The fact that the lines of the drifts of the *Fram* and the *Sedov* crossed in several places has made it

possible to determine the changes in the thermal balance of the Arctic Basin during the last forty-five years.

The *Sedov* remained twice as long beyond the 85th parallel as the North Polar Expedition on the drifting icefloe, and two and a half times as long as the *Fram*, though the drift of the latter lasted nearly three years. The *Sedov* began her drift considerably farther south than the *Fram*, and at the end of it she descended to more southerly latitudes than Nansen's vessel, yet the *Sedov's* drift lasted only 26½ months. This indicates that the speed of the *Sedov's* drift was considerably greater than that of the *Fram*.

The increased movement of ice from the Arctic Basin into the Greenland Sea is accompanied by an increase in the flow of warm Atlantic waters into the polar basin, a reduction in the volume of ice in seas bordering on the Arctic, a decrease in the thickness of polar ice and size of glaciers, and also by a rise in the winter temperatures of the air. All these phenomena are characteristic of the warmer temperatures we are now observing in the Arctic.

Notwithstanding the fact that the line of the *Sedov's* drift was considerably more northerly than the line of the *Fram's* drift, the winter months in the Arctic in Nansen's time were several degrees colder than at the present time. The lowest temperature of the air (−44·1°) was registered by the *Sedov's* crew on March 10, 1939, at lat. 86° 23′ N., long. 110° 20′ E. The lowest temperature during the drift of the *Fram* (−52°) was registered on January 15, 1896, approximately at lat. 84° 55′ N., long. 41° E., that is, appreciably more south-west than the spot where the *Sedov's* lowest temperature was registered and where, as a rule, it is warmer.

The thickness of level ice according to the measurements of the *Sedov's* crew was not more than 218 cm. (7 ft. 2 in.). Nansen's expedition encountered ice 365 cm. in thickness. Analysis has shown that the lesser thickness of the ice in the region of the *Sedov's* drift was due not so much to the rise of the winter temperatures of the air as to the melting of the ice in recent years in summer time.

Belt of Hummocks

In the light of the observations made by the *Sedov's* crew, interest is attached to questions concerning the maximum thickness of the ice. The members of the North Polar Expedition on the drifting icefloe never encountered ice of a greater thickness than 218 cm. That being the case, where was the icefield on which the expedition set up its observation station formed, and how did it reach the North Pole? We know that this icefield was more than 3 m. thick. Why was the *Sedov*, which on March 22, 1939, was 180 km. (97·12 nautical miles) farther to the north than the *Fram* and afterwards, like the *Fram*, turned westwards, unable to penetrate to the 87th parallel? The highest latitude reached by the *Fram* was 85° 55·5′; the highest latitude reached by the *Sedov* was 86° 39·5′. The northernmost point reached by Nansen during his sledge journey to the North Pole was lat. 86° 14′; lastly, in 1900 Cagni in the same region reached lat. 86° 34′ N. Both Nansen and Cagni were prevented from going farther north by impenetrable hummocky ice.

These data should be compared with the observations made by Alexeyev during his flights from Franz Josef Land to the North Pole and back. Alexeyev ascertained that from Rudolf Island up to lat. 82° 30′ N. lie hummocky fields of young ice dotted with icebergs. Higher, up to lat. 85° 30′ N., the size of the icefields increases, reaching 20 km. across. On these fields are level platforms suitable for the landing of aeroplanes. At the 84th parallel the thickness of the ice did not exceed 100–120 cm. Beyond 85° 30′ commenced an icefield of ice many years old, while up to the 86th parallel the icefields were small and hummocky, and the lanes between the icefields were filled with broken ice. In these places it was impossible to land aeroplanes. Farther north, particularly between 87° and 88° 30′, the icefields appeared more suitable for landing-places. The condition of the ice in the region of the North Polar Expedition on the drifting icefloe is already known.

From the foregoing, we see that between the North Pole and Franz Josef Land is situated a belt of hummocks of a peculiar character. This belt separates the younger ice, formed mainly on the continental shelf of Eurasia, from the thicker ice near the North Pole. It seems that this belt of hummocks which, in its time, had stopped the further advance to the north of Nansen and Cagni, is a permanent feature.

Nansen's Laws

Four times a day the men on the *Sedov* transmitted by radio their position and meteorological observations. This made possible a comparison of the ice drift with the wind causing the drift. Such observations made near coasts are usually distorted by the nearness of land and shallows; and so, for a theoretical study we are only able to use the data supplied by three drifts, those of the *Fram*, of the Papanin North Polar Expedition on the drifting icefloe (while it was in the central part of the Arctic Ocean) and of the *Sedov*.

Like all known drifts, the drift of the *Sedov* did not proceed in a straight line. The ice-breaker often turned back on her course, described zigzags

and even loops. These changes of direction were caused by changes in the direction and velocity of the wind. In this connexion, very characteristic are the figure 8 described by the *Sedov* between October 2 and 26, and the zigzags between November 10 and 30, 1938, and the loop she made between January 3 and 17, 1939.

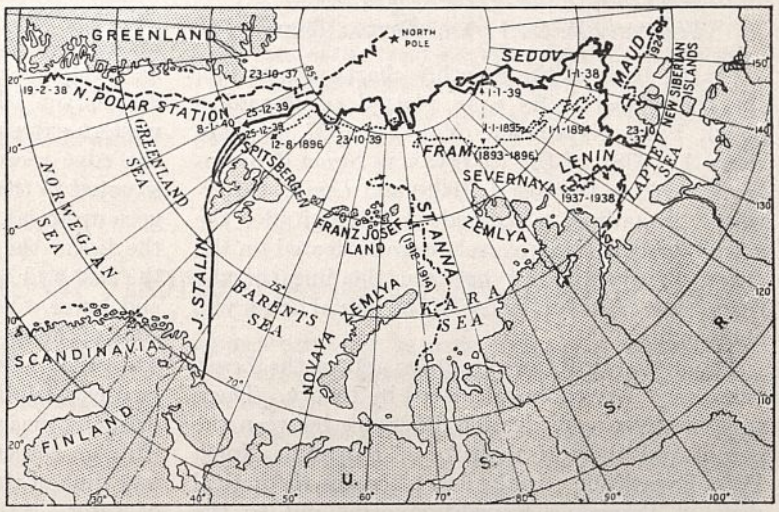
The only difference between the direction of the drift and the direction of the wind was that the drift was deflected 30°–40° to the right. Any deviation from this law can be attributed to the incompleteness of the *Sedov's* observations at my disposal.

The observations of the *Sedov* worked out by me show that in the region where the *Sedov* drifted between September 1, 1938, and February 1, 1939, the constant current was so weak that it might be said to have been absent. As a result, almost laboratory conditions prevailed for the study of the relations between wind and drift. Far removed from the distorting influence of land and constant currents, the wind drift was shown here practically in its pure form.

In this way it was possible to confirm yet again the exactness of the two simple laws of Nansen determining the behaviour of solid ice in the central part of the Arctic Basin. These laws are as follows :

(1) The speed of the wind drift is approximately one fiftieth of the velocity of the wind causing the drift.

(2) The drift of the ice is deflected from the direction of the wind by 30°–40° to the right owing to the influence of the deflecting force of the earth's rotation.



DRIFTS OF THE *Maud*, *St. Anna*, *Fram*, THE ICE-BREAKERS *Lenin*, *Sedov* AND PAPANIN'S NORTH POLAR EXPEDITION, AND ALSO THE COURSE OF THE ICE-BREAKER *Joseph Stalin*.

TWO ADDITIONAL LAWS

A study of the drift of the *Sedov* makes it possible to add to Nansen's two laws two other equally simple laws :

(3) The drift of the ice follows the isobars. The ice drifts along these lines in such a way that the region of high pressure is to the right of the direction of the drift, and the region of low pressure to the left.

(4) The drift of the ice takes place at a speed proportional to the gradient of atmospheric pressure, or in other words, inversely as the distance between the isobars.

The first of these additional laws is not difficult to deduce. In moderate and high latitudes the wind, due to friction against the surface of the earth and to the influence of the deflecting force of the earth's rotation, is directed approximately 30°–40° to the left of the corresponding isobar. The drift of the ice, according to the second of Nansen's laws, is deflected from the direction of the wind approximately by 30°–40° to the right. Combining the two, we arrive at the drift of the ice along the isobar.

The second additional law was arrived at thus In the absence of constant currents and the deflecting influence of land, the ice moves at a speed proportional to the velocity of the wind. The latter, in its turn, is proportional to the gradient of atmospheric pressure ; the closer the isobars are drawn on the synoptic chart for any given region, the stronger are the winds in that region. From this, supported by purely theoretical deductions, it was possible to judge from the synoptic chart not only the direction of the ice drift, but also its speed.

Theoretical calculations made on the basis of the new laws confirm the hypothesis that the ice moves clockwise around the so-called 'pole of inaccessibility'. Had the *Sedov* in January and February 1939 been somewhat more north than she actually was at that time, it is highly probable that she would have been drawn into this clockwise movement around the 'pole of inaccessibility' and would have been drifting now towards the northern coasts of America.

The new laws offer an explanation of the known drifts of vessels and buoys and also of such arctic phenomena as 'Peary's polynia' at the coast of Greenland, also the 'Great Siberian polynia' stretching with interruptions from the New Siberian Islands to the Chukotsk Sea. These polynias

coincide with the lines of separation of the ice, or in other words, with the lines of the divergence of the isobars.

The movement of the ice along the isobars also explains why Amundsen's *Maud*, when entering the ice at Wrangel Island for the purpose of drifting across the North Pole, moved with the ice along the continental slope of the Asiatic coast, that is, along the parallel and not the meridian. It appears that the isobars in the vicinity of Wrangel Island both winter and summer stretch along the parallels. In order to drift with the ice to the North Pole it would be better to enter the ice in the region of the Beaufort Sea, whence, apparently, the icefield occupied by Papanin's North Polar Expedition was carried.

Theoretical Drift and Actual Drift

On the basis of the monthly charts of pressure, the theoretical drifts were plotted of Papanin's North Polar Expedition (May 21, 1937, to February 1, 1938), of the ice-breakers *Sedov* (November 1, 1937, to October 1, 1938) and *Lenin*. Afterwards, according to latitude and longitude, the actual drifts of these vessels were indicated on the chart. The similarity between the lines of the theoretical drifts and those of the actual drifts was noteworthy.

The actual drifts of the *Sedov* and of the *Lenin* came very near those calculated by theory. There was, however, considerable difference between the actual and theoretical drifts of Papanin's North Polar Expedition. In the first place, the theoretical drift of Papanin's Expedition came out to the coast of Greenland, and in the second place, it was shorter than the actual drift (if calculated by latitude) by 550 nautical miles. This difference is accounted for by the fact that in calculating the theoretical drifts, account was taken only of the influence of local winds, whereas the movement of the ice is conditioned not only by winds, but also by constant currents.

Naturally, in regions where the constant currents are weak, the influence of local winds on the speed and direction of the drift is paramount. With the approach to the Greenland Sea, the local winds, owing to the strong East Greenland current, have less and less influence on the icefields. The weak winds, the direction of which is contrary to that of the constant current, now only slow down or delay for a time the general drift to the south. This happened in the case of Papanin's North Polar Expedition, and also in the case of the *Sedov*.

The difference between the actual and theoretical drifts of the Papanin North Polar Expedition is also connected with the speed of the wind drift of mass icefields in the central Arctic. This is one fiftieth of the velocity of the wind causing the drift; but the speed of the drift of ice under the influence of wind is considerably increased if ahead of the ice, in the direction of the wind, is open sea. In this case, the speed of the drift may reach one tenth of the velocity of the wind or sometimes even more. Conditions such as these are created when north and west winds prevail in the region of the central Arctic adjoining the Greenland Sea, or in the Greenland Sea itself.

In this sea, along the east coast of Greenland right up to lat. 60° N., summer and winter there moves to the south an uninterrupted line of polar ice carried from the Arctic Basin by the East Greenland current. At the same time, to the north, along the west coasts of Scandinavia and Spitsbergen, flow warm Atlantic waters, which as a deep current later penetrate into the Arctic Basin. Owing to this, the eastern edge of the Greenland ice stretches approximately from Iceland through Jan Mayen Island to the north, up to the north-western extremity of Spitsbergen. In the summer, the edge recedes to the west, and in the region situated to the north of Spitsbergen, in some years goes up to lat. 82° N. In winter-time, the edge of the ice in the Greenland Sea moves somewhat to the east and at Spitsbergen descends to lat. 80° N. and lower. With western and northern winds the edge of the ice recedes to the east, the ice becoming somewhat less closely packed; with eastern and southern winds the edge of the ice recedes to the west and the ice becomes much more closely packed. Thus in the eastern part of the Greenland Sea at any time of the year are immense ice-free stretches of water.

The Greenland Stream

Every year there flows into the Arctic Ocean about 5,000 cubic kilometres of river water. In addition about 30,000 cubic kilometres of Pacific waters and more than 100,000 cubic kilometres of warm Atlantic waters flow into the Arctic basin through the Bering Strait annually. A small proportion of this water passes into the Baffin Sea but the bulk flows into the Greenland Sea through the broad strait between Greenland and Spitsbergen, forming the East Greenland current. This current is maintained and considerably strengthened by the north and north-west winds which predominate on the east coast of Greenland.

As observations have shown, in the central basin, the speed of the constant current towards the Greenland Sea is not great: it is less than one nautical mile a day. But on approaching the Greenland Sea and within the Greenland Sea, the speed of the constant current increases. According to the calculations of Shirshov and Fedorov (of Papanin's North Polar Expedition), near the 83rd

parallel the speed of the constant current towards the south reaches 4 km., near the 80th it is 6 km. and near the 75th parallel it is 9 km. a day.

At the end of August 1939, reaching the northernmost point of her drift, the *Sedov* began quickly to descend to the south-west, becoming gradually drawn into the Greenland current. From December 1, 1939, the drift proceeded due south, almost parallel to the drift of Papanin's North Polar Expedition, almost at the same speed with which the latter had drifted in that region two years previously.

During the period of its drift, Papanin's North Polar Expedition descended about 1,120 nautical miles to the south latitudinally. This route was covered under the influence of the constant current and local winds. If account is taken of the data of Shirshov and Fedorov concerning the direction and speed of the current, it appears that about 600 nautical miles of the total length of the drift was due to the accompanying sea currents, and only 520 nautical miles to accompanying winds. At the same time, the theoretical drift for the *Sedov* was shorter than the actual drift by 550 nautical miles, because when plotting it, we gave consideration only to local winds.

Taking into account the observations and calculations of Shirshov and Fedorov, we attempted to calculate the entire drift of Papanin's Expedition caused, on one hand, by the distribution of atmospheric pressure, and on the other, by the constant current. The results of this calculation made by myself with the help of my assistant, Mr. Somov, are of interest. Comparing the actual position of Papanin's North Polar Expedition on February 1, 1938, with the theoretical position, calculated according to my formulæ, with due account of the constant current, we find that the actual position of the Expedition differed from the theoretical position only by 50 miles in latitude, or only by 5 per cent of the total length of the drift in latitude. This comparison may be regarded as bordering on the limits of accuracy with which the original data were obtained.

DEVELOPMENT OF LONG-RANGE AIRCRAFT*

AEROPLANES as a means of transport become increasingly attractive as their range increases. For short journeys the saving in time is often negligible, especially in a country in which other forms of carriage are well developed, but on long routes, particularly trans-oceanic services, the time saved may amount to days or even weeks. Long range demands large fuel capacity, and the peculiar conditions in aircraft may reduce the pay load until it becomes uneconomic, and eventually the limiting range is reached over which no pay load can be carried. The principal problem associated with this is the difficulty of taking a heavily loaded aeroplane off the ground. When flying free, a heavier-than-aircraft is capable of carrying a much bigger load than that which it can lift off the surface of a normal aerodrome. The hazard of a heavily loaded take-off is considerable, particularly when the machine has just left the ground. If at this moment there should be an engine failure (and it is a time when engines appear to be liable to fail, due possibly to some small maladjustment during their overhaul since last being run, which develops into a failure catastrophically) the results will almost certainly be serious, as it is necessary to land at high speed with little or no choice of landing site.

It was with these points in mind that Sir Alan Cobham began several years ago to develop his system of refuelling in flight. His aim was to allow an aircraft to take off light, with very little of the required fuel on board, which on a long-range machine may amount to as much as 25–30 per cent of its all-up loaded weight. Its take-off would thus be comparatively safe, as its preliminary run would be short and the climb away from the ground relatively steep until it has reached a safe operating height. A flying tanker would then come alongside and deliver the fuel to give it range. This scheme has been successful in the regular operation of the North Atlantic service by Imperial Airways Limited last summer, in which the *S*.30 flying boats were refuelled at Foynes or Botwood before they commenced the ocean crossing. These flights are to be resumed during this summer, and will probably continue until the ice on Botwood Harbour closes them down for the winter.

Many methods of assisting the take-off have been suggested, and they may be classified under four headings :

(1) *Improvement of Thrust.* (*a*) Controllable pitch airscrews. (*b*) Ground boosting of the power plant, including the use of high-octane fuel.

* Based upon (1) "Report on the Effects of Large Increments in Wing and Power Loadings on the Performance of Aircraft" by Marcus Langley ; (2) "Static Electricity in Relation to Refuelling in Flight" by Marcus Langley and H. M. Barlow ; (3) "Landing Speed and Ceiling in Relation to Refuelling in Flight" by Marcus Langley Flight Refuelling Limited, Ford Aerodrome, Yapton, Arundel, Sussex.)

(*c*) Catapulting, inclined runways, etc. (*d*) Mayo Composite aircraft.

(2) *Reduction of Drag.* Reduction of coefficient of friction by means of bogey on rails, concrete runways, etc.

(3) *Improvement of Lift.* (*a*) Flaps of various designs, including mechanical variation of wing camber. (*b*) Makhonine's span-wise variation of area. (*c*) Use of slipstream and angle of thrust line relative to wing, according to the Crouch-Bolas patents. (*d*) Mayo Composite aircraft.

(4) *Reduction of Weight.* Addition of fuel, subsequent to the take-off, by the methods of Flight Refuelling Ltd.

Combinations of these methods are found in the design of most modern transport and military aircraft. Thus it is now usual to fit an air liner with controllable-pitch airscrews, ground-boosted power plants, and low-drag flaps, to gain some advantage from the slipstream in improved lift, and to operate it from aerodromes having concrete runways. It is only by these methods that loadings as high as those now used are possible, but these are far from being the optimum loadings in flight.

Certain of the methods, particularly those which imply the use of specially prepared aerodromes, are not suitable for military aircraft. Others are not particularly suitable for passenger purposes. For example, the acceleration of a catapult used for a passenger transport would have to be relatively low, and consequently its design would be elaborate, and its cost, weight and dimensions prohibitive. In any event, unless such methods assist the initial climb in order to clear obstructions outside the aerodrome, as well as shorten the take-off run, they provide only a partial solution of the problem. This suggests an alternative classification of these methods :

(*a*) those which are substantially safe ; and
(*b*) those which introduce a hazard.

Under the second heading might be put catapults, inclined runways, over-sized aerodromes, and, in fact, any method the assistance of which is withdrawn at the moment the aircraft leaves the ground.

Refuelling is of greatest value in allowing the operation of trans-oceanic air routes of 3,000 miles or more, where no intermediate landing is possible. There is an agreed international limit for take-off run by which a civil aircraft must be able to clear a 60 ft. barrier 656 yards from its starting point. It is possible to design a normal modern air liner capable of carrying a reasonable pay load over a distance of 3,000 miles, and to keep within this limit of take-off. Additional range, demanding extra weight of fuel, can only be had at the expense of lengthening the take-off run and reducing the angle of climb, or alternatively reducing the pay load. If the machine were refuelled after leaving the ground, its take-off could be reduced by half.

A similar air liner could be designed which, with the aid of refuelling, would be able to fly 5,000 miles with about the same pay load as that carried by the normal machine for 3,000 miles, and its take-off run would still be less than 400 yards with an angle of climb of $11\frac{1}{2}°$. The corresponding normal aircraft would require more than 1,000 yards if it had to take this load off the ground, and it could climb at an angle of only 5°.

Many practical problems have had to be solved before the process could be considered sufficiently safe and reliable for everyday use. A complete set of equipment has been developed for both the tanker aircraft and the machine which receives the fuel. Flying problems have had to be explored, so that the operation could be carried out in any condition of weather in daylight or at night.

It is now simple and quick. The receiving aircraft flies a straight and level course when it has climbed to its operating height. It streams out a hauling line with a sinker weight attached through the receiver coupling in its tail, and the tanker comes up behind and to one side, and fires a line across this. The contact thus having been established, it is a simple matter to attach the nozzle of the hose pipe to the receiving aircraft's hauling line. The hose is paid out and the nozzle pulled by a windlass into the coupling, where it is retained by hydraulically operated claws. During this coupling-up process the tanker has climbed into the refuelling position above, behind and to one side of the liner. Approximately 200 ft. of hose is used for a separation between the aircraft of 100 ft. The hose thus trails back in a hairpin bend, and if it were to break or come adrift it would fall clear of both machines. The coupling is non-jammable and is fitted with an automatic release, so that the nozzle will come away should it be necessary for the aircraft to part in an emergency. For the Atlantic service, a 2-in. bore hose was used, and with a gravity head of 60 ft. the rate of flow was of the order of 110 gallons a minute. The whole process of transferring 800 gallons took 12–15 minutes, of which about five minutes was spent in making contact and getting the hose across, and some seven minutes in actually passing the fuel.

Among the many interesting secondary problems were those associated with static electricity. The two aircraft might be at a different potential and charges might be built up in the hose pipe due to friction. There was a further chance of electrification by splash as the petrol rushed into the receiving tanks. Methods have been evolved to

overcome all these possible dangers. The two machines are completely bonded together throughout the whole process by means of the spiral steel wire armouring on the outside of the hose pipe. The whole system is flushed through with nitrogen from the tanker both before and after the passing of the petrol. At the moment of break-away, the contents of a bottle of methyl bromide are automatically sprayed into the receiver coupling, and the final contact is eventually broken in mid-air by snapping a weak link in the hauling line as the aircraft part company.

It is difficult to foresee all of the ramifications of the post-War developments of civil aviation, but the establishing of rapid transport of mails and passengers over the long ocean routes between the continents is one of the most obvious. This will scarcely be possible as a self-supporting economic proposition with present-day aircraft, unless in the meantime some revolutionary discoveries are made either in the aerodynamic design of aircraft, or in the design of power units. It is possible to visualize at least an approach to this ideal by making use of refuelling in flight, using the most up-to-date design of aircraft as now accepted. During the War its development is going on, but little may be said about its possibilities for military purposes.

OBITUARIES

Dr. R. T. Gunther

WE regret to record the death on March 9 of Dr. Robert William Theodore Gunther, a great student of science and the founder in the Old Ashmolean Building of the Oxford Museum for the History of Science. With him there passes the last of the Oxford science tutors appointed in the early and middle 'nineties and a learned, aloof, enigmatic, single-minded and essentially good man.

Gunther was born in 1869, the eldest son of Dr. Albert Günther, the zoologist, and educated at University College School, London, and Magdalen College, Oxford. He had wide scientific interests as a boy—in geography, chemistry, practical mechanics and biology. The combined influences of his father and of Ray Lankester, whom Gunther greatly admired, led him to take his B.A. degree in biology. He obtained, as one could in those days, a first class in morphology in 1892, and shortly afterwards was appointed tutor in science at Magdalen. A few years later he became a fellow. Few men read science at Magdalen in the 'nineties, and Gunther, unlike the busy tutor of to-day who divides his time between work and research in the laboratory and tutorial hours in college, was a free man. He went with an endowment to Naples to work in the Marine Laboratory there, and between 1897 and 1914 travelled widely, studying the natural history of lakes in Persia and the geology of extinct volcanoes and surveying the entire coast-line of Italy. His first publications were on subjects in biology and geology, but his intense devotion to the memory of Prof. Charles Daubeny of Magdalen College helped to deflect his interests from the present to the past, from Nature to documents and instruments, from research in laboratories to pieces in museums. His history of the Daubeny Laboratory of Magdalen College came out in 1904, and annotated registers of those who had worked in it were published in 1916 and 1924. His love of collecting material relating to the past and arranging it for publication was shown in his monographs on his own family, on his wife's family, on the monuments in Magdalen Chapel, and similar subjects, brought out in the period 1910–14.

After the War of 1914–18, Gunther devoted himself to collecting for exhibition scientific and mathematical instruments of the past, especially of Oxford's past, and to editing the little-known or forgotten works of Oxford's early scientific men, of whom Robert Hooke was first favourite. In the period 1920–37 he brought out no fewer than eleven volumes on these men and their works, in addition to works on astrolabes, early libraries, and other subjects. Anything 'early' and 'scientific', even in Cambridge, whatever its present relevance or value, interested him greatly and, he believed, would interest others too. One old instrument, blunt and rusty, one old book, with a few good scientific ideas in it, gave him joy when ninety-nine particle-counters or up-to-date text-books left him lukewarm. It was unfortunate that some of the publications received adverse and even trenchant criticism. It was not that Gunther was constitutionally inaccurate or that he would not take sufficient trouble with his material ; it was that he would do everything himself. He never collaborated or took advice. He went his own way. He did his best. When up against a difficulty he preferred to surmise rather than to seek someone who knew the answer. This temperamental weakness was best revealed in his large work on early astrolabes where criticism which he could have got in Oxford, indeed, in his own College, was delivered more vigorously than helpfully after, instead of before publication.

During the War of 1914–18 Gunther became curator of the Botanic Garden in Oxford, and from 1920 until 1923 the librarian of Magdalen. In the 'twenties the rooms in Daubeny's buildings, where he was amassing his instruments and books, with Daubeny's eighteenth century chemical-ware as its nucleus, were needed as lecture rooms and laboratories. Gunther took it ill when his College asked him to leave and take the material elsewhere. There was,

in consequence, a breach, inevitable between a College alive to the needs of the twentieth century and one who was essentially a seventeenth century antiquarian. The breach, however, brought out the best in Gunther's fighting qualities. He determined that Oxford should have a museum for the history of science that would be unique. Almost no one in Oxford but himself was interested in that kind of museum. He set out, decisively and even gallantly, to achieve his purpose. He had a talent for relating means to ends, for making just so much impression on individuals and colleges as would extract from them what he wanted, for doing just so much canvassing as was needed to gain his particular point in the courts of the University. At times he did not invite, he commanded; city magnates came to Oxford to unveil memorial windows; presidents of the Royal Society came at his bidding to commemorative luncheons; chancellors and heads of colleges signed his appeals in *The Times*. In 1924 he became the curator of the Lewis Evans collection of scientific instruments, and this nucleus became the museum for the history of science in the Old Ashmolean building in Broad Street, Oxford, in 1935. To-day the collection is unique and, but for the War, would be in a lovely setting. Gunther's single-handed fight to collect this material and to get it into the building, where it now is, will not have been in vain if someone can now be found to succeed him as curator and in the University readership in the history of science. The museum is his fine achievement, a witness to what one man by himself can do.

Gunther married Amy Neville-Rolfe, daughter of a former consul-general at Naples. He had two sons, the elder of whom was zoologist to the recent *Discovery* expeditions. A. S. RUSSELL.

Prof. D. S. Margoliouth, F.B.A.

WE regret to record the death of Prof. D. S. Margoliouth, for many years a foremost authority in Oriental studies and formerly Laudian professor of Arabic in the University of Oxford, which took place on March 22 in the Middlesex Hospital, London, at the age of eighty-one.

David Samuel Margoliouth was born in 1858 of Hebrew Polish stock. The son of an Anglican missionary to the Jews, he was educated at Winchester and New College, Oxford. Both at school and at the university he was of outstanding ability, and showed a remarkable and unusually early maturity in classical studies, being awarded both the Hertford and the Ireland Scholarships in his first year as an undergraduate. Later he turned to Oriental studies, winning all the University prizes open to him in this field. In 1881 he was appointed fellow and lecturer in classics; and eight years later he entered upon his occupancy of the Laudian professorship, which he held until his retirement only three years ago.

Margoliouth's knowledge of the Arabic language and literature was universally recognized as unrivalled in either Europe or the East. His unremitting activity in this branch of Oriental studies was devoted to the editing and elucidation of the more difficult and obscure of classical Arabic texts. Here his greatest achievement was his monumental edition of Yakut's "Dictionary of Learned Men". Next to this must be ranked his work in collaboration with H. F. Amedroz on the Abbasid chronicles of Miskawaihi. Commentators on Aristotle and the Old Testament also engaged his attention—he produced an edition of the Poetics—and he collaborated with Dean Payne Smith in the "Thesaurus Syriacus".

Those who are acquainted with Margoliouth only through his more highly specialized literary and linguistic studies may possibly fail to realize how deep and wide were his interest in and knowledge of the content of the texts he studied and, in short, of the whole range of the thought, culture and beliefs of the peoples of the Arabic tongue. His profound knowledge of the early development of Islamic belief is to be observed in some degree in his Hibbert Lectures delivered in 1913 and in the two books which appeal to a wider audience, "Mohammed and the Rise of Islam" and "Mahammedanism", the latter a volume in the Home University Library. His erudition was ever freely at the service of those whose studies lay in any cultural sphere impinging in any way upon his own, and appeal for enlightenment was never made in vain.

The Polish Government Information Department has issued a communiqué stating that up till February 1 the following professors, among others, of Polish universities have died in the concentration camp Sachsenhausen-Oranienburg, or have died since their release from camp:

Tadeusz Grabowski (philosophy);
Antoni Hoborski (mathematics);
Kazimierz Kostanecki (comparative anatomy);
Jan Nowak (geology);
Feliks Rogoziński (physiology);
Adam Różański (agricultural mechanics);
Michał Siedlecki (biology) [see NATURE, March 30, p. 492];
Jerzy Smoleński (geography);
Władysław Takliński (technology);
Antoni Wilk (astronomy);
Jan Włodek (agriculture).

We regret to announce the following deaths:

Prof. J. W. Beede, formerly professor of geology in Indiana University, an authority on the geology of Texas, on February 27, aged sixty-eight years.

Prof. Alexandre Besredka, chief of the section of microbiology of the Paris Pasteur Institute, aged seventy years.

Prof. S. M. Dixon, O.B.E., formerly professor of civil engineering in and dean of the City and Guilds College, London, on March 25, aged seventy-two years.

Mr. J. A. Hobson, the well-known economist, on April 1, aged eighty-one years.

Prof. A. E. Norton, since 1935 Gordon McKay professor of applied mechanics in Harvard University, on February 24, aged sixty-two years.

The Faraday Society

MARCH, 1940

On the Fluorescence and Absorption Spectra of Anthracene and Phenanthrene in Solutions. By S. Sambursky and G. Wolfsohn.

The Photochemistry of Antimony Oxide. By G. Cohn and C. F. Goodeve.

Dielectric Loss in Polystyrene Mixtures. By F. C. Frank and Willis Jackson.

Propagation of Temperature Changes through Textiles in Humid Atmospheres.
Part I.—Rate of Absorption of Water Vapour by Wood Fibres. By G. King and A. B. D. Cassie.
Part II.—Theory of Propagation of Temperature Change. By A. B. D. Cassie.
Part III.—Experimental Verification of Theory. By A. B. D. Cassie and S. Baxter.

The Rate of Reaction of Sodium Atoms with Polyhalogenated Methane Derivatives. By J. N. Haresnape, J. M. Stevels and E. Warhurst.

The Theory of the Formation of Protective Oxide Films on Metals, II. By N. F. Mott.

The Polymerisation of Ethylene by Alkyl Radicals. By Joseph C. Jungers and Lourdu M. Yeddanapalli.

The Surface Tensions of Methyl Acetate Solutions. By J. W. Belton.

Monolayers of a Long Chain Ester Sulphate. By Einar Stenhagen.

The Conversion of Parahydrogen by Porphyrin Compounds, including Hemoglobin. By D. D. Eley.

Luminescence of Substances under Flame Excitation. By L. T. Minchin.

Isomorphorus Relationships of Some Organic Compounds of Analogous Constitution. By N. M. Cullinane and W. T. Rees.

APRIL, 1940

Studies in Membrane Permeability. II. The Adsorption of Sucrose and two Salts on Cupric Ferrocyanide. By B. C. McMahon, E. J. Hartung and W. J. Walbran.

The Catalytic Exchange of Hydrogen Atoms between Molecular Deuterium and Propane and Butane. By A. Farkas.

Calculation of the Third Law Entropy of Ethyl Chloride. By J. W. Linnett.

The Chemisorption of Olefines on Nickel. By G. H. Twigg and E. K. Rideal.

Elastic Recovery and Plastic Flow in Raw Rubber. By L. R. G. Treloar.

Nuclear Gold Sols. III. Lower Limit of Particle Size. By A. Baker and F. L. Usher.

The Effect of Hydrochloric Acid on the Viscosity of Barium and Magnesium Chloride Solutions. By A. S. Chacravarti and B. Prasad.

Viscosity of Electrolytic Mixtures in Dilute Solution. By A. S. Chacravarti and B. Prasad.

An Electron Diffraction Study of the Surface Reaction between Bickel Oxide and Corundum. By H. R. Thirsk and E. J. Whitmore.

The Dielectric Constant of Diamond. By L. G. Groves and A. E. Martin.

The Latent Photographic Image; Additivity of Part-Exposures and Microcrystalline State of Silver Halide Grains. By J. C. M. Brentano and S. Baxter.

Monolayers of Compounds with Branched Hydrocarbon Chains. I: Di-substituted Acetic Acids. By E. Stenhagen.

Note on Hearts of Formation of Ethyl and Propyl Peroxides. By E. C. Stathis and A. C. G. Egerton.

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NEWS AND VIEWS

CHAIR OF CRYPTOGAMIC BOTANY AT MANCHESTER

Prof. W. H. Lang, F.R.S.

THE Barker chair of cryptogamic botany in the University of Manchester will be vacated at the end of the academic year by its present tenant, Prof. W. H. Lang. His successor has been appointed in the person of Dr. Claud Wardlaw, officer in charge of the Low Temperature Research Station at Trinidad. He is expected to take up his duties in the autumn. The founder of the Barker chair was himself an expert in the study of mosses : and his aim was to secure not merely instruction, but also general research upon those lower forms of plant life which the title of the chair connotes. In order to secure this double result, such periods of advanced teaching as are demanded from the professor are limited, thus leaving opportunity for research to him and to his pupils.

Since such conditions are exceptional, the appointment to the Barker chair commands a special interest. The distinction of its out-going occupant is well known, and was recognized by the award of a Royal Medal in 1931. Prof. Lang, having qualified in medicine in the University of Glasgow, drifted into the specialized pursuit of botanical science after having graduated with distinction also in science in 1894. In the years that followed he carried out various researches, chiefly upon archegoniate plants and gymnosperms. These marked him out as an acute experimentalist and observer, so that when the Barker chair was founded in 1909 the appointment seemed naturally to fall to him. From the first his use of observed fact was strictly critical, and his approach to constructive conclusions very guarded. These qualities are such as are specially required in palæophytology, towards which circumstances seemed to have been conspiring to guide him. For while still officially in Glasgow he had become acquainted with that prince of palæontologists, Robert Kidston, of Stirling : and was not Manchester the place where Williamson had enshrined his own peculiarly exact study of fossil plants ?

After Lang's appointment to the Barker chair, the results of a happy co-operation with Kidston culminated in the five memoirs "On Old Red Sandstone Plants showing Structure, from the Rhynie Chert Bed, Aberdeenshire". Published in the *Transactions of the Royal Society of Edinburgh* (1916–1921), this series, together with that of Kidston and Gwynne-Vaughan on "The Fossil Osmundaceæ", will stand for all time as twin models of method in palæophytological research. Moreover, each deals with results of supreme importance to the comparative morphology of vascular plants. The Rhynie memoirs are perhaps the most striking record of Prof. Lang's researches. But since their completion, his laboratory has been a centre of elaboration of palæontological method, and of its application to other fossils, particularly those of very early time. He has thus laboriously gathered data which, though largely dealing with isolated facts, will ultimately take their place in the jig-saw puzzle, still very imperfectly sketched, of the earliest flora of the land.

Dr. C. W. Wardlaw

DR. C. W. WARDLAW, officer-in-charge of the Low Temperature Research Station, Imperial College of Tropical Agriculture, Trinidad, has been appointed to succeed Prof. Lang. Dr. Wardlaw graduated in 1921 with first-class honours in botany in the University of Glasgow and was immediately appointed assistant to the professor of botany, Prof. F. O. Bower. He carried on the Bower tradition with research on size and form in stellar structure and developed research and teaching in mycology at Glasgow. Three years later he took the Ph.D. of Glasgow and was appointed lecturer. He was sent to study mycology under Brown at the Imperial College of Science and Technology, London, and also visited Prof. Chodat's summer school in Switzerland. He took his D.Sc. degree with papers on size and form and studies on the Lanarkshire strawberry disease. He was often called in as consultant on various diseases in Scotland. In 1929 Dr. Wardlaw was appointed mycologist at the Imperial College of Tropical Agriculture, Trinidad, and undertook investigations into diseases of the banana. Later he took charge of the investigations of cold storage in particular reference to the mycological aspects, and has travelled a great deal in the West Indies and in the north of South America.

It may be thought that to appoint an expert on banana investigations as successor to so distinguished a palæontologist as Prof. Lang would be a dangerous experiment, but Dr. Wardlaw is in point of fact an all-round botanist, with a bias towards the Cryptogams. His first work was on a parasitical disease of cultivated strawberries. Then followed three searching memoirs on "Size and Internal Morphology", with illustrations, mainly cryptogamic, drawn to uniform scale. Later came a series of memoirs on the fungal diseases of the banana ; and again, another series based on experiments at the Low Temperature Research Station at Trinidad. These deal with that phase of physiology which is involved in the successful transport of tropical fruits to serve the home markets. Such results, together with descriptive records of wide travel among the West Indian Islands and on the mainland of Central America, reveal Dr. Wardlaw as a botanist of broad interests, who has used his exceptional opportunities for observation and reasoning to good purpose. A botanist so versatile in what he has already accomplished may be trusted to continue the tenure of the Barker chair along lines in accord with the will of its founder.

Royal Irish Academy: New Professor of Theoretical Physics

AT the election meeting of the Royal Irish Academy in Dublin on March 16, it was announced that Dr. Erwin Schrödinger had been appointed professor of theoretical physics in the Academy as from April 1. The funds for the professorship are being supplied to the Academy by the Irish Government. Prof. Schrödinger has been giving a course of lectures on wave mechanics at University College, Dublin, since November last. This course has had a large attendance from members of the two Dublin Colleges. It will be continued now in the Royal Irish Academy.

It is believed that the institution of this professorship is intended as a temporary measure, pending the setting up of an institute for theoretical physics in Dublin, in which Prof. Schrödinger will have a permanent appointment. The recent publication of the text of a Bill making provision for the new institute shows that Mr. de Valera does not intend the financial difficulties arising out of the War situation to upset his plans for the development of higher mathematical studies. In addition to mathematics and theoretical physics, the mention of cosmology, geophysics and even chemistry in the Bill may be taken as indicating that Mr. de Valera has in mind the possibility of the institute broadening the scope of its studies in the future. There is also to be an institute for the promotion of higher Celtic studies.

Prof. H. Arctowski

WITH home, laboratory, and invaluable records of years presumably irrevocably lost during the War, Prof. Henryke Arctowski, formerly honorary professor of geophysics and meteorology in the University of Lwow, has begun work at the Smithsonian Institution on the direct effects of changes in the sun's radiation on weather conditions on the earth. Prof. Arctowski is recognized as one of the greatest authorities on world weather. He has now started with renewed enthusiasm on the correlation of solar and terrestrial phenomena from the comprehensive records of the Smithsonian Astrophysical Observatory. He has already made significant—although for the present tentative—findings of apparent cause-and-effect relationships between the variation of solar radiation and terrestrial weather conditions.

John Dixon Mann

DR. JOHN DIXON MANN, an eminent Manchester toxicologist, was born in 1840 at Kendal, where his father was borough treasurer. He received his medical education at the Manchester Royal School of Medicine and qualified M.R.C.S. and L.S.A. in 1862. For many subsequent years he was engaged in general practice in Manchester, but in 1880 he became M.R.C.P.(Lond.) as well as M.D. of St. Andrews, and confined himself to consultant practice. In 1882 he was appointed physician to the Salford Royal Hospital, and three years later became lecturer in forensic medicine and toxicology at Owens College, Manchester, in succession to Dr. C. J. Cullingworth, who was elected professor of obstetrics and gynæcology. The lectureship was converted into a chair in 1892. Dixon Mann's principal work, "Forensic Medicine and Toxicology", which won him the Swiney Prize awarded by the Royal College of Physicians of London and the Society of Arts, went through four editions between 1893 and 1907 and was for many years the standard work on the subject. His other book, entitled "On the Physiology and Pathology of the Urine with Methods for its Examination", appeared in 1904 and was followed by a second edition in 1908. He also made numerous contributions to periodical medical literature including the *Medical Chronicle*, the now extinct Manchester journal, which contains a bibliography of his writings. He died on April 6, 1912.

Hindu and Moslem in India

THE course of recent events in India tends to confirm apprehension, such as has found expression in the columns of NATURE from time to time while the terms of the new constitution were under consideration, lest the introduction of the forms of Western democracy among a population of so heterogeneous a character in culture, creed and tradition might encounter difficulties well-nigh insuperable. It was hoped by those responsible for decision that the communal solution would at once secure the rights of minorities and ensure their acquiescence in the rule of the majority which is essential for the successful working of democratic institutions. It has been made evident by subsequent events that the necessary community of outlook was lacking. This is to be seen on one side in the breakdown under provincial autonomy, on the other in the difficulty in formulating a scheme of federation in which the claims of democracy can be reconciled with the autocracy of the native States and the fears of the Princes lest they should endanger rights based upon tradition and further secured by the treaty with the British Crown.

A situation which bristles with difficulties and requires the most delicate handling has been brought within measurable distance of a crisis in the turmoil of world events. The Indian Congress, the representative body of the Hindu community, has seized the opportunity to put forward a claim for the grant of that independent status for India towards which it was hoped the new constitution would serve both as a stage and a training ground. This claim the Moslem League has countered by a demand for the recognition of separate Moslem and Hindu nations within the bounds of India. The demand is by no means so fantastic as it may appear at first. Apart from the fact that the voice of a minority of some eighty millions or more, sectional differences for once forgotten, cannot be ignored, it is based upon a very real difference in a cultural tradition, as every student of Indian civilization is aware; for the Moslem tradition fosters a democratic outlook while fearing and resenting a Hindu domination in an independent India, which would from its immemorial tradition of caste be essentially oligarchic in practice. However impracticable the Moslem demand may be, no

solution will secure the future of India in world affairs or internally which attempts to ignore or override these fundamental differences of culture and tradition.

New Government Technical School at Takoradi

THE opening of the new Government Technical School at Takoradi introduces a further development of this type of education in the Gold Coast. Increased demand for technical instruction necessitated the removal of the school from Accra, where the accommodation proved to be inadequate. Moreover, the new site is more favourably placed in relation to the industrialized area of the Gold Coast. The new Technical School occupies a prominent site overlooking the sea and Takoradi Harbour, and the more important buildings include a long single-story workshop with blacksmith's shop at the rear, a three-story administration block containing classrooms, laboratories, drawing offices, assembly hall and dining-room and a dormitory block capable of housing one hundred students. The workshop is in two sections, one for practical work in mechanical engineering and the other for practical woodworking. Both sections are fitted with modern electrically driven machinery such as lathes, power drills, shapers, etc., in addition to the usual benches for manual work.

Other buildings include the European housemaster's bungalow, two blocks of quarters for eight African masters, a block of six labourers' quarters, a large timber-drying store, petrol store and garage. The buildings are grouped around a five-acre sports ground. In addition, there are facilities for safe sea-bathing and boating. The buildings are fitted with electric clocks controlled by a master clock; most of the classrooms and the assembly hall are wired for the reception of wireless re-diffusion from the Sekondi broadcasting station; and there is complete water-borne sanitation. Candidates for admission must be in possession of a Standard VII Certificate or its equivalent. Present students include boys from Nigeria, Dahomey and all parts of the Gold Coast. Among entries for next year are three boys from Sierra Leone. The total cost of the scheme has been approximately £37,500, which includes approach roads, laying out of grounds, etc., the area covered by the school and grounds being some thirty acres.

Fishery Research in the Italian Empire

THE rapidity of scientific development in the new Italian Empire is well illustrated by the subject of aquatic biology. Only three years have elapsed since the conquest was complete, and yet the recently formed Direzione Superiore Affari Colonizzazione e Lavoro has already set up an Ufficio Idrobiologia e Pesca at Addis Ababa, under the direction of Prof. P. Parenzan, and a considerable amount of preliminary research has taken place on the inland waters of the former Ethiopia. These are described in the first number of a new official journal entitled *Bollettino di Idrobiologia, Caccia e Pesca*. It is a well-appointed publication, containing papers on fish, their importance in the food of native peoples, parasites and pathology, and accounts of other aspects of the biology of fresh waters, including the fish-eating birds and Mollusca.

Meanwhile, in the past half century, the vastly greater areas of lakes and rivers in British eastern Africa, containing correspondingly greater resources, have been subjected only to spasmodic and short-term scientific examinations, and most of these have resulted from the initiative of individual scientific workers or institutions not immediately concerned with colonial development. Perhaps the new policy in colonial research and development which has recently been announced by the Colonial Secretary may lead, after the War, to the inclusion of fisheries in both the sea and fresh waters in a widely planned scheme of research.

Paratypical Forms in Man's Line of Descent

IN a discussion, and incidentally a criticism on certain points, of the announcement of the discovery in Java of an upper jaw attributed to *Pithecanthropus erectas* (see NATURE, **144**, 926; 1939), Prof. G. Montandon brings forward a suggestion which he argues would resolve certain of the difficulties inherent in apparent discrepancies in the evidence (*Rev. Scientifique*, **78**, 1; 1940), and maintains that had Dr. von Koenigswald included the palatal view of the jaw in the figures accompanying the announcement of the find, it would have been evident that Pithecanthropus stands outside the Hominidæ. Prof. Montandon says that its shape is that of the U characteristic of the anthropoid jaw and not that of the horseshoe form found in man. Further, the simian diastema separating the incisors and canines is present here, though never found in man. At the same time, this disparity does not warrant classification of the jaw as that of a gibbon or other form of anthropoid. For, as Prof. Montandon goes on to point out, the teeth and especially the canines are not Simian but those of a Hominid. Comparison of the jaw with that of Sinanthropus definitely places the latter as belonging to a more advanced type and within the Hominid group.

The discussion becomes even more suggestive when Prof. Montandon passes on to consider the significance of Dr. Broom's recent discoveries in South Africa. Here in Paranthropus is a form which shows a like combination of incompatible characters. In cranial form Paranthropus is more Simian than Hominid, but at the same time in form of jaw and teeth it is the reverse. The jaw shows the horseshoe form, the absence of diastema, and a humanoid dentition. Prof. Montandon therefore goes on to ask the question, pertinent on his interpretation of the evidence, whether there may not be another form in which, as with Pithecanthropus, the cranium approaches the human more nearly than do the Paranthropoids of South Africa, but less human than them in respect of the dental arch. His further suggestion of a whole series of paratypes of wide distribution raises an interesting and wide question which at present rather hangs in the air.

Evolution Restated

THE mathematicians and physicists refer things no longer to three axes of co-ordinates, but to four, the fourth being the time axis. The world is 'four-dimensional', and is a world of *events*. This conception of time as intrinsic to things and not just something that happens to them, is applicable to the biological no less than to the physical sphere, and leads to interesting results, especially as bearing upon the theory of evolution. Some of these corollaries have been indicated by Mr. J. C. McKerrow in a pamphlet "Evolution without Natural Selection" (London: Longmans, Green and Co., Ltd.) supplementing his "Novius Organum" (1931). The Darwinian theory was that out of a number of chance or random variations a certain number were chosen by 'natural selection' to survive. The difficulty for the Darwinian has always been to account, not for 'natural selection' or survival, but for the occurrence of the variations themselves. But it is obvious that if an organism is a 'four-dimensional process' or a system of activity, an event and not a thing, it is not so much variations as repetition and sameness that call for explanation. In a world of events, things happen, whereas in a world of static fixtures, they do not.

Mr. McKerrow, like Samuel Butler, interprets organic activity (and an organism which as a four-dimensional process *is* itself an event, that is, activity, not a thing) in terms of habit. Habit accounts for sameness or stability, but it also accounts for variation, because it does not exclude freedom. "All the forces of nature that make for change are just as much available on the assumption of 'habit' as on that of mechanistic causation—with an additional element of 'fortuity' added". On this view, variations are not so much random as "manifestations of the peculiar degree of freedom of living systems". Evolution on this view is positively, not negatively, conditioned. Hypothetical variations are not produced in order to be massacred by natural selection. It is just a case of a four-dimensional Nature displaying its activity in new happenings. In any event a four-dimensional biology can scarcely leave unchanged our views of the mode of evolution.

Antimony Treatment of Kala-azar

AN article under this title by Sir Leonard Rogers appeared in NATURE of December 16, 1939, p. 1103, which presented in very bare outline the history of the use in India of antimony compounds to combat kala-azar. Sir Upendranath Brahmachari, whose work in connexion with the introduction and use of urea stibamine was referred to briefly, has submitted to NATURE a long statement surveying in some detail the work which led up to the preparation of this substance and reporting on the results obtained. He states that, contrary to Sir Leonard Rogers' statement, urea stibamine was not patented, and claims that divergent results obtained by different investigators were due to the fact that various manufacturers put on the market so-called urea stibamine which did not conform to his specification. Reference is also made to the cost of treatment with antimony compounds. Sir Leonard Rogers stated in his article that a course of treatment with urea stibamine cost £3 in 1925. In the intervening years, this has happily been reduced; Sir Upendranath states that urea stibamine is now supplied by the Government at Rs. 1 per gram, and since 1·5 gm. is sufficient for complete cure, the total cost of the drug to-day is now Rs. 1·8 (about 2*s*. 3*d*.). This is a reduction on which all who have been concerned are to be congratulated. Yet this cost is still relatively high for a country in which the great majority of the population live dangerously near the starvation line, and there is still room for a rapidly effective and really cheap remedy for kala-azar.

American Archæology and Local Research

IN view of recent references in NATURE to the stimulation of local interest in archæological research in the United States of America through Federal, National and State funds, it may be of interest to note that the Research Committee of the American Philosophical Society, in awarding grants in the natural and exact sciences from the Penrose Fund in 1938–39, allocated amounts as follows for localized anthropological and archæological investigations. These are additional to continuing grants for researches to which reference is made in another column of this issue of NATURE (see p. 558). To Emil W. Hanry, of the University of Arizona, for the excavation of a prehistoric village on Forestdale Creek, Fort Apache Indian Reservation, Arizona, an area of direct contact between the Mogollon and Anasazi cultures, 500 dollars; Margaret Lantis, University of California, for an ethnographical study of the complete seasonal round of the year of Alaskan Eskimo, 950 dollars; and Louis W. Chappell, West Virginia University, for the collection and preservation of folk-lore in West Virginia, 500 dollars. The last-named research should prove of special interest in view of its bearing upon cultural exchange between the three strains of white, Indian and Negro. The Indian in the past has suffered in both directions of over-idealization and undue depreciation arising from culture clash. The scientific study of Indian cultures by ethnographical and archæological methods is rapidly widening appreciation in truer perspective.

History of Artificial Eyes

THE January issue of the *Annals of Medical History* contains an interesting account, accompanied by numerous illustrations, of the ancient origins of artificial eyes by Dr. Gordon M. Bruce, of New York. The earliest artificial eyes about which there is definite information were made in Egypt for the adornment of mummies, mummy masks and statues, of which many varieties are to be seen in museums. Artificial eyes have also been found in Aztec and Inca mummies, as well as in mummified specimens from Darnley Island in the Torres Strait and the Solomon Islands. The ancient Syrians were familiar with the use of artificial eyes, as is shown by a specimen in the Metropolitan Museum of New York. The existence

of artificial eyes in Babylonian times has recently been proved by the discovery of a cuneiform inscription of about 1600 B.C., in which 22 artificial eyes, 9 of agate and 13 of chalcedony, are mentioned. In ancient Greece statues were often provided with artificial eyes, Pheidias's statue of Athena being a celebrated example. In ancient Rome the *faber ocularius*, or maker of artificial eyes, existed as well as the *medicus ocularius*, who was a favourite subject for contemporary satirists, especially Martial. There is no definite description of artificial eyes to replace those lost by disease or accident before the middle of the sixteenth century, when they are mentioned by Ambroise Paré, but, as Dr. Bruce points out, the terms in which he speaks of them do not indicate that they were an innovation at that time.

The Development Commission

THE twenty-ninth report of the Development Commissioners, for the year ending March 31, 1939, has just been published (H.M. Stationery Office. 2*s*.). The total sum recommended for the fund was £625,642, of which agriculture and rural industries accounted for £579,480, and fisheries and harbours £46,162. These grants, particularly in the latter case, were rather smaller than in the previous year, when the amounts were £608,911 and £131,555 respectively. A short section describes the subject of study, size of staff and total sums available for expenditure at each of the agricultural research institutes in receipt of grants from the Fund, but details of their work are supplied in other publications. Results accruing from grants are necessarily difficult to assess, but it must be remembered that it is largely through her research institutes that Great Britain maintains such a close touch with agricultural science throughout the world, and has been able to assist in Empire development through supplying trained men.

As regards rural industries, the greater part of the sum allocated has taken the form of grants to the Rural Industries Bureau. The latter exists both to help the craftsmen for their own sakes and to maintain the village workshop for the sake of the country. By its advisory service and the introduction of improved equipment and methods of business it is hoped to secure the interest of the younger generation in industries of vital importance to the farmer. Investigations undertaken by the Fishery Departments are largely carried out under schemes adopted by the International Council for the Exploration of the Sea. Both the English and Scottish share of the investigations receive support from the Fund, and grants have also been made for research on freshwater fisheries.

Colorimetry of Electric Discharge Lamps

IT is claimed in the *G.E.C. Journal* of February that during last year very satisfactory progress was made in developing various types of technique for improving electric discharge lamps. Unsolved problems in heterochromatic photometry and colorimetry previously stood in the way. The problem was complicated by the practical application of fluorescent discharge lamps to domestic and other forms of interior lighting. This made it necessary to measure the colour-rendering properties of the light sources in a way distinct from their colour. Although non-selectively reflecting surfaces or fabrics, such as 'whites' or 'greys', will have the same coloured appearances when illuminated by light from such sources, since reflection by these surfaces produces no change in the spectral energy distribution of the light, the coloured appearance of selectively reflecting surfaces, such as dyed fabrics, may be quite different. Therefore, although the colour of these two light sources is the same, their colour-rendering properties are different, and it is this latter property which it is desired to measure.

Two types of measurement are made: (*a*) the determination of the most desirable colour-rendering properties of light sources when performing different tasks at different illuminations (this involves major research into chromaticity scales under different observational conditions); (*b*) the recording of the spectral luminosity distribution of light sources already established as satisfactory for particular purposes, so that the manufacture of such lamps can be controlled in a manner to ensure uniformity of colour-rendering properties of the commercial lamps or fittings. These measurements are carried out by visual photometric measurements of spectral luminosity made, in turn, through a series of spectral filters which transmit light only within defined wavelength limits. This involves a comparatively simple technique which can be undertaken commercially with photometric apparatus. For differentiating and defining the colour-rendering properties of many electric discharge lamps, this method is not sufficiently sensitive. One recent method, which is being used to define the luminosity distribution throughout the spectrum, utilizes physical photometric methods of measuring the relative luminosity in eight suitably chosen adjacent spectral bands, extending throughout the physical spectrum.

Trench Fever

IN his inaugural thesis (*Thèse de Paris*, No. 870; 1939), Dr. Robert Schapiro remarks that since the War of 1914–18, during which trench fever was very prevalent both on the French and Italian fronts as well as in Salonica and Mesopotamia, endemic cases have been reported in the south of France and Russia. It is also probable that many cases have passed unrecognized. Reports received from Spanish doctors living in their own country or as refugees in France indicate that there has been an outbreak of the disease in Spain, although Schapiro has been unable to obtain confirmation of this from other sources. The possibility, however, of a return of the disease must be recognized in view of the fact that defective hygienic conditions, and particularly the presence of lice among the troops, favour the spread of trench fever.

Moreover, the risk of its occurrence is increased by the transfer last autumn of German troops from east to west, as the disease is undoubtedly more

prevalent in Central Europe than in the west. Soldiers, however, are not the only persons liable to contract the disease, although they were chiefly affected during the Great War, but owing to the contacts between the army and the civil population the latter are also liable to become infected, especially in the case of large agglomerations and refugees. Although trench fever is not a serious disease in itself, it may be the cause of a considerable degree of invalidism, as is shown by the fact that Sir Wilmot Herringham calculated at eight million the total number of days off duty in the British Army due to this cause. Prevention consists in immediate isolation of the first cases, delousing of contacts and other methods for the destruction of lice.

Miniature Circuit-Breakers

THE *Electrical Review* of March 29 points out that an amendment has been made by the Standards Association of Australia to its wiring rules, by a provision that the loading of final sub-circuits may be increased if sealed circuit-breakers of an approved type are used in place of fuses. In this case two general purpose socket outlets in a room of a dwelling-house can be counted as one if connected with an 8, 12 or 18 ampere final sub-circuit, and any permanently connected appliance rated at 100 watts or less may be counted as a lighting point. It is stated that in many cases the additional cost of the circuit-breaker will be largely offset by the reduction in the number of fuses required. While the Wiring Rules of the Standards Association of Australia differ materially from the Regulations of the Institution of Electrical Engineers, thus precluding the possibility of direct comparison, the value of a circuit-breaker the setting of which cannot be tampered with would in many cases be high.

The Science Masters' Association

THE report for 1939 of the Science Masters' Association records a rapid growth in membership. Last year no fewer than 914 schools were represented, whereas twenty years ago there were only 143. So extensive a combination can produce effective action, which we notice in the first annual report of the London and Home Counties Branch. Suggestions on the new physics syllabus of the London General School Examination were made after discussion, sent to the general committee of the Association, passed on, and accepted. The result is changes which are announced to "take effect in the physics paper at the next examination".

Memorandum on Scabies

SCABIES, or the 'itch', is a superficial inflammation of the skin caused by infestation with the itch mite, the female of which burrows into the skin producing much irritation. The affection is very liable to occur among collections of persons living together in restricted circumstances such as are met with in war-time, among evacuee children, soldiers and others. The Ministry of Health has therefore issued a useful memorandum on the subject (Memo. 229/Med. H.M. Stationery Office. 2*d*. net). It describes the affection and its complications, diagnosis, methods of spread and prevention, and the treatment.

The Iron and Steel Institute

MR. JOHN CRAIG, chairman and managing director of Messrs. Colvilles, Ltd., has been elected president of the Iron and Steel Institute for the next two years. Mr. Craig will be inducted into the presidential chair by the retiring president, Lord Dudley, at the annual general meeting on May 2. The Bessemer Gold Medal for 1940 of the Institute has been awarded to Dr. Andrew McCance, of Glasgow, in recognition of his eminent services in connexion with the application of science to the iron and steel industry. Dr. McCance is a director and general manager of Messrs. Colvilles, Ltd. M. Eugène Schneider has been nominated an honorary member to celebrate the fiftieth anniversary of his election to membership. M. Schneider joined the Institute in 1890 and was president for the period 1918–20. An Andrew Carnegie Silver Medal has been awarded to Mr. Bo W. L. Ljunggren for his memoir entitled "Method of Sclero-grating employed for the Study of Grain Boundaries and of Nitrided Cases; Grain Structures revealed by Cutting". The Williams Prize for 1939 has been divided between Mr. W. B. Lawrie, for his paper on "The Refining of Metal in the Basic Open-Hearth Furnace. The Influence of Fluorspar on the Process", and Mr. W. T. Wilson, for his paper on "The Rolling of Sections at the Appleby-Frodingham Steel Company, Limited." No papers have been received in competition for the Ablett Prize for a paper on a subject connected with engineering in iron and steel works written by a junior engineer. Captain Ablett has renewed the offer of the Prize for competition in 1941. Particulars can be obtained from the Secretary of the Institute; papers must be submitted not later than January 31, 1941.

Announcements

THE annual joint meeting of the Institute of Radio Engineers and the American Section of the International Scientific Radio Union will be held at the National Academy of Sciences, Washington, D.C., on April 26. A programme of abstracts will be available in booklet form about April 15. Correspondence should be addressed to S. S. Kirby, National Bureau of Standards, Washington, D.C.

A RESEARCH department for racial hygiene has recently been created in the Welfare Ministry in Japan. It is preparing a new law on marriage and sterilization.

ACCORDING to the United States National Health Survey the prevalence of blindness is greater among men than among women. For every one hundred blind women, one hundred and eleven men were affected. Nearly twice as much blindness was found among coloured people as among white.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They 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.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 554. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Mass of the Universe

I FIND certain difficulties in connexion with the mass of the universe considered as a finite sphere of radius $4{\cdot}9 \times 10^{23}$ miles and of volume $5{\cdot}2 \times 10^{71}$ cubic miles. Eddington gives the mass of the universe as 10^{22} stars averaging our sun in weight. Taking $2{\cdot}0 \times 10^{27}$ tons as the sun's weight, then the mass of the universe would be $2{\cdot}0 \times 10^{49}$ tons. There are, says Eddington, $1{\cdot}575 \times 10^{79}$ electrons and an equal number of protons in the universe. Assuming the mass of these units to be respectively $9{\cdot}038 \times 10^{-28}$ gm. and $1{\cdot}65 \times 10^{-24}$ gm., then the weight of the electrons must be $1{\cdot}4235 \times 10^{52}$ gm. and that of the protons $2{\cdot}598 \times 10^{55}$ gm.; their combined masses would amount to $2{\cdot}599 \times 10^{55}$ gm. or $2{\cdot}55 \times 10^{49}$ tons, which is a fairly close approximation to the weight of the universe calculated on the basis of stars.

But is not this mass, of the order of $2{\cdot}0 \times 10^{49}$ tons, too low? It would appear to leave out of account the mass of the radiations (photons) that are being poured out by luminous stars into practically every nook and corner of the $5{\cdot}2 \times 10^{71}$ cubic miles of space. Our own sun, we are told, is losing $4{\cdot}0 \times 10^{6}$ tons of matter every second while emitting in the same period of time an equivalent of energy, $3{\cdot}8 \times 10^{33}$ ergs. As the sun is an average representative of the stellar bodies, it follows that the totality of 10^{22} stars comprising the universe is losing $4{\cdot}0 \times 10^{28}$ tons of matter per second, and is emitting in the same time $3{\cdot}8 \times 10^{55}$ ergs.

Hubble, taking a shorter radius ($8{\cdot}23 \times 10^{23}$ miles) and a smaller volume ($1{\cdot}92 \times 10^{63}$ cubic miles) of the universe, gives his estimate of its mean density as $1{\cdot}5 \times 10^{-31}$ gm. of matter per cubic centimetre, that is, about a gram to every $6{\cdot}6 \times 10^{30}$ cm.^{3}, or in more homely weights and measures, about a pound mass in every $7{\cdot}2 \times 10^{17}$ cubic miles. Apart from the energy-equivalent of the matter in space (say $4{\cdot}08 \times 10^{23}$ ergs per pound), what is the mean quantity of the energy of radiations (photons) per unit volume—a cubic centimetre or a cubic mile—of space? Would not the mass of this, added to that of matter, afford a more trustworthy basis for calculating the total mass of the cosmos than a basis which takes into consideration matter alone?

CHARLES M. BEADNELL.

Hollywood,
Egham,
Surrey.

UNDOUBTEDLY, the mass of the radiation should be added to the mass of the stars and of the nebulous matter in computing the total mass of the universe. But the general belief is that its contribution is comparatively small—less than 1 per cent of the whole. This is not inconsistent with the figures cited by Admiral Beadnell. With radiation at the rate of 4×10^{28} tons per second, it would take 5×10^{18} seconds, or more than 10^{11} years, to accumulate to 1 per cent of the total mass 2×10^{49} tons. According to cosmological theory, the age of the stars can scarcely exceed 10^{10} years.

Perhaps Admiral Beadnell was thinking in terms of a former time-scale, based on the hypothesis of mutual annihilation of protons and electrons, which allowed an age of 10^{13} years or more. Owing to the discovery of the positron, neutron, etc., this hypothesis (always very dubious) has, I think, no adherents to-day. According to present theories, the source of a star's radiant energy is the transmutation of hydrogen into other elements. This means that less than 1 per cent of the mass of the universe has been, or ever can be converted into radiation. It may be noted that when the mass of the universe is computed from the total number of protons and electrons, no correction for the mass of the radiation is required, since it merely compensates the mass-defect of the nuclei formed by the transmutation.

A. S. EDDINGTON.

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Cambridge.

Turnover Rate of Nucleic Acid

CASPERSSON'S work[1] on the nucleic acid metabolism suggests that an appreciable turnover of the nucleic acid present in the nuclei of tissue cells may take place. This fact induced us to determine the rate of turnover of nucleic acid extracted from various organs of rabbits by making use of the method of isotopic indicators applied previously to determine the turnover rate of various other phosphorus compounds.

The labelled sodium phosphate used as indicator was administered all through the experiment in order to keep the activity of the plasma inorganic phosphorus at a constant level. After the lapse of a few hours or days, the nucleic acid was extracted from some of the organs. A slightly modified form of Hammarsten's method[2] was used. The turnover figures, recorded in Tables 1 and 2, were obtained by comparing the specific activity (activity per mgm. phosphorus) of the nucleic acid phosphorus extracted at the end of the experiment with the average specific activity of the cellular inorganic phosphorus which prevailed during the experiment. The value of the activity of the cellular inorganic phosphorus is obtained from that of the tissue inorganic phosphorus after subtracting the share due to the extracellular space of the tissue. The specific activity of the inorganic phosphorus present in the interspaces is

TABLE 1.
TURNOVER OF NUCLEIC ACID IN THE COURSE OF 11·5 HOURS. WEIGHT OF THE RABBIT: 2·4 KGM.

Fraction	Specific activity	Percentage renewed during the experiment
Liver inorganic P at the end of the experiment	100	
Liver cellular inorganic P average during the experiment	69·5	
Liver nucleic acid P	4·0	5·7
Muscle inorganic P at the end of the experiment	18·2	
Muscle cellular inorganic P average during the experiment	10·2	
Muscle nucleic acid P	1·4	13·7
Thymus inorganic P at the end of the experiment	90	
Thymus cellular inorganic P average during the experiment	63	
Thymus nucleic acid P*	3·8	6

* In an experiment lasting 4 hours, the specific activity of the thymus nucleic acid was found to be 2·8 per cent of that of the plasma inorganic phosphorus.

taken to be equal to the specific activity of the plasma inorganic phosphorus. The latter is found, after 4 hours for example, to be 2·5 times as large as the specific activity of the liver inorganic phosphorus. From this figure, and the result obtained that from 100 inorganic phosphorus atoms present in the tissue 3 are located in the interspaces, it follows that from 100 activity units present in the tissue 8 are located in the interspaces and, thus, the specific activity of the cellular inorganic phosphorus at the end of the experiment is equal to 92/97 of that of the tissue inorganic phosphorus. As we have determined the change of the specific activity of the tissue inorganic phosphorus with time, we can calculate the average value of the specific activity of the cellular inorganic phosphorus prevailing during the experiment.

In experiments in which all the labelled phosphate was administered to rats at the start, we found, after the lapse of 24 hours, the specific activity of the liver nucleic acid phosphorus to amount to 28 per cent of the specific activity of the liver phosphatide phosphorus. In a laying hen, after the lapse of 5 hours, the corresponding figure was found to be only 5 per cent.

As seen in Tables 1 and 2, an appreciable turnover of the nucleic acid takes place in all the organs investigated. While, however, all other organic phosphorus compounds present in the liver were found by us to be entirely renewed in the course of a few days, as long as after the lapse of 50 days two thirds of the nucleic acid molecules present in this organ were found to be unchanged. In the muscles, on the other hand, the turnover of the average nucleic acid molecule is more rapid than in the liver or in the thymus. In the brain the turnover rate of the nucleic acid was found to be markedly lower than that of the phosphatides.

TABLE 2.
TURNOVER OF NUCLEIC ACID IN THE COURSE OF 50 DAYS. WEIGHT OF THE RABBIT: 2·5 KGM.

Fraction	Percentage renewed during the experiment
Liver phosphatide P	100
Liver nucleic acid P	33
Muscle phosphatide P	73
Muscle nucleic acid P	93
Brain phosphatide P	77
Brain nucleic acid P	27

All the above data are calculated on the assumption that the inorganic phosphorus atoms incorporated into the newly formed nucleic acid molecules have the same specific activity as the average cellular inorganic phosphorus. It is possible that the penetration of inorganic phosphorus into the nuclei is a slow process and that, correspondingly, the formation of labelled nucleic acid molecules inside the nuclei took place with the participation of phosphorus atoms less active than the average cellular phosphorus. In that case the turnover figures recorded in Table 1 do not represent the proper turnover rates but only their lower limit, and the actual turnover rate of the nucleic acid is still greater than stated above.

In experiments *in vitro*, no exchange was found between the phosphorus of the nucleic acid and that of sodium phosphate, as was to be expected. 100 mgm. thymonucleic acid, kindly presented to us by Prof. Hammarsten, were dissolved in 4 c.c. water, and 0·01 gm. labelled phosphorus as sodium phosphate was added. After shaking the solution for 1 hour, the nucleic acid was precipitated by adding an excess of 1/3 *N* alcoholic hydrogen chloride solution. The precipitate contained only a minute activity. We conclude that less than 1/4000 of the nucleic acid phosphorus was replaced by labelled phosphorus.

L. HAHN.
G. HEVESY.

Institute of Theoretical Physics,
University, Copenhagen.
Feb. 26.

[1] Caspersson, T., *Skand. Arch. Physiol.*, Suppl. to **73** (1936).
[2] Hammarsten, E., *Biochem. Z.*, **144**, 383 (1924).

Thermal Expansion of Invar

IT is well known that invar possesses a coefficient of linear expansion which is much smaller than those of other metals, and that measurement of its expansion over a restricted range in the region of room temperature is a matter of some difficulty. It is therefore thought worth while to direct attention to a method of measuring the coefficient of expansion which is very unusual in that it is unnecessary to know the length of the rod the coefficient of which it is desired to measure.

Joule[1] showed that when a longitudinal tension of F dynes is suddenly applied to a metal rod, there results an adiabatic change of energy $\triangle E$, resulting in a fall of temperature $\triangle T$, given by $\triangle E = J\rho.s.\triangle T = \alpha TF/A$, where α is the coefficient of linear expansion, T is the absolute temperature, J the mechanical equivalent of heat, and ρ, s and A are respectively the density, specific heat and area of cross-section of the rod. It is seen that the quantity $J\rho.s$ is the number of ergs per c.c. which must be imparted to the rod to raise its temperature by 1° C.

Now, invar is ferromagnetic, and, by taking the rod round one half of a hysteresis cycle, a quantity of energy $\triangle E'$ equal to $\int_{-H}^{+H} HdI$, is liberated as heat; this produces a rise in temperature $\triangle T'$ given by $\triangle E' = J\rho.s.\triangle T' = \int_{-H}^{+H} HdI$. If, therefore, we

can measure $\triangle T$ and $\triangle T'$, and can calculate $\int_{-H}^{+H} HdI$ from magnetic data, we know α, since it is equal to

$$\frac{\triangle T}{\triangle T'} \cdot \frac{A}{T.F.} \int_{-H}^{+H} HdI.$$

In a recent letter in NATURE[2], we mentioned a new method of measuring the heat generated step by step in a hysteresis cycle. We have now applied this method to an invar rod 0·473 cm. in diameter, purchased from Messrs G. P. Wall, Sheffield. We find that at 7·6° C., the temperature within our cooled solenoid, the calculated value of $\int_{-190}^{+190} HdI$ is 2,984 ergs per c.c., which gives a total deflection of 0·91 cm. with our temperature measuring device. The sudden application of a longitudinal tension of 36·75 kgm. to the rod results in a deflection of 7·21 cm. The ratio $\triangle T/\triangle T'$ is therefore equal to 7·92 and $\alpha = 0{\cdot}411 \times 10^6$ per degree C., correct, in our view, to less than 2 per cent.

Unfortunately, no specimen of superinvar[3] (63·5 iron, 32·5 nickel and 4 cobalt) is at our disposal, but we see no reason why its coefficient of linear expansion should not be obtained in the same way. The method as described above is applicable to ferromagnetic substances only, but it could be modified to deal with non-ferromagnetic materials.

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March 7.

[1] Joule, J. P., "Collected Works", 1, 426; *Phys. Soc. Lond.*, 1884.
[2] Bates, L. F., and Weston, J. C., NATURE, **145**, 188 (1940).
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Liberation of Potassium from Muscle by Acetylcholine

POTASSIUM appears to increase the liberation of acetylcholine from frog's heart (Beznak[1]), from the superior cervical ganglion (Brown and Feldberg[2,3]) and from other organs (Feldberg and Guimarais[4]). But it has been found[5,6] that muscles curarized with erythrina, cobra venom, curare, etc., are nearly or completely insensitive to intra-arterial injections of acetylcholine, whereas they react normally to potassium. It may therefore be inferred that if both compounds intervene in the nervous transmission, acetylcholine acts by the intermediate liberation of potassium probably from some organic compound as suggested by Reginster[7] for striated muscles, and Dulière and Loewi[8] for the central nervous system of the frog.

If the sciatic artery of a toad is perfused with potassium-free Ringer solution containing acetylcholine at a concentration of 1×10^{-6} or more, the contracture of the muscles is accompanied by an increase in the concentration of potassium in the liquid flowing from the vein.

Denervated muscles which respond more readily to acetylcholine liberate ten times more potassium than normal muscles, and curarized muscles which do not react to acetylcholine liberate no potassium.

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[1] Beznak, A. B. L., *J. Physiol.*, **82**, 129 (1934).
[2] Brown, C. L., and Feldberg, W., *J. Physiol.*, **84**, 12P (1935).
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Relationship between the Critical Temperatures, Boiling Points and the Parachor Values of Simple Molecules

IN previous publications[1,2], it has been pointed out that the critical temperatures and boiling points of chemically related substances containing the same number of molecules are linear functions of the parachor values P, and the van der Waals factor b has been shown to be similarly related. It was suggested that the applicability of such a relation to a distinct series was probably due to the similarity of cohesional and configurational functions characterizing a particular group. Recently, an interesting regularity was observed which gives considerable support to this suggestion.

The simple electronic conception of valency pictures the combination of atoms as being due to the preferential arrangements of the outermost electronic sheaths, but the factors giving rise to the known cohesive force which exists between neutral molecules are still a matter of conjecture. It is extremely probable that this cohesive force is governed to a large extent by the arrangement of electrons around the neutral molecules taken as a whole, and that the major part of the cohesive effect is exerted by those electrons which do not participate in a true 'valency bond'. Thus, a consideration of the following molecular types readily gives n, the number of electrons exerting a 'cohesive effect'.

Type	Inert Gas	Halogen acid	Halogen
	:Ne:	H × Cl:	:Cl × Cl:
n	8	6	12

The following table gives the derived equations for the critical temperatures taken from the original paper[1]. It is remarkable that in each case the coefficient of P when divided by the function n gives an almost constant result.

Group	Equation	k (coeff. of P)	n	k/n
Inert gas	$T_c = 3{\cdot}7P - 48$	3·7	8	0·465
Halogen acid	$T_c = 2{\cdot}72P + 130$	2·72	6	0·453
Halogen	$T_c = 5{\cdot}57P - 188$	5·57	12	0·465

A similar regularity exists when the boiling point/parachor equations for a distinct series are considered, and it seems to show that the electrons in a molecule which do not participate in chemical bond formation play an important part in determining the magnitudes of the physical constants.

It is apparent that the general equation, $T_c = 0{\cdot}465\,nP$ + const. will apply to all the above types of molecules, where n has the previous significance.

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[1] *J. Chem. Soc.*, 263 (1938).
[2] *J. Chem. Soc.*, 1058 (1938).

An Apetalous Mutation in Turnip (*Brassica campestris* L.)

DURING the year 1938–39 a stray plant of Brassica was discovered, in a lucerne field, which looked strikingly different from any of the plants in the very extensive collection of oleiferous Brassicas which were being grown for cytogenetic study. An examination of this erect, compact plant showed that the flowers were devoid of the bright yellow petals characteristic of the genus and that this was the reason for its peculiar appearance. A number of unopened buds were dissected and examined and in every case it was found that the stamens were inserted immediately after the sepals, the whorl of petals being absent. Seed-setting was excellent under conditions of both self- and open-pollination. The chromosome number of the plant was determined at pollen meiosis as $n = 10$, that is, the same as in ordinary turnip, which it closely resembled in morphological characters.

Crosses between the apetalous plant and turnip were made reciprocally, seed-setting in both cases being quite normal. During the current season the crossed, selfed and open-pollinated seeds of the plant were sown. The seeds from the apetalous plant (both selfed and open-pollinated) gave rise to apetalous plants resembling the parent, whilst the crossed seeds gave rise to hybrids which had petals like the turnip parent. Fig. 1 shows the parents and the hybrid and Fig. 2 is a close-up view of the flowers of the apetalous and turnip parents. It is clear from the data above that the apetalous character is heritable and recessive to the petalled condition.

Apetalous form Hybrid Turnip
Fig. 1.

Apetalous form Turnip
Fig. 2.

There is no previous record, so far as I am aware, of the occurrence of any variety in which an apetalous condition is inherited. The only comparable case in literature is that in maize, in which Sprague[1] has reported a mutation in which the glumes were suppressed and the anthers consequently exposed. This mutation in maize is dominant, while in the present case the absence of petals is a recessive character. It is probable that this apetalous plant also arose as a mutation.

The importance of this mutation lies in its possible practical application. Many oleiferous Brassicas are self-sterile and new varieties evolve by mass selection or otherwise rapidly degenerate when grown in the field, owing to cross-pollination. Even if self-fertile forms are obtained, the maintenance of purity of the stocks and their further improvement presents a problem because of the extensive cross-pollination which still goes on. The apetalous plant, however, is not only self-fertile but also self-pollinating and provides an easy means of detecting the hybrids resulting from outcrosses, in its progeny, as such hybrids will possess petals and stand out conspicuously among the apetalous plants. Thus heterozygous plants can be easily rogued and the purity of the strain maintained. Furthermore, the apetalous character, being recessive, can easily be bred into other strains.

As regards the extent of cross-pollination occurring in this plant, it is noteworthy that out of about a hundred plants raised from the seed of the original plant, not a single hybrid was obtained. Preliminary observations this season also show that the amount of cross-pollination must be very low. One row of the apetalous plants was grown between rows of normal plants and daily observations were made of the numbers of visiting insect pollinators.

It was found that these pollinators (chiefly bees) showed a decided preference for the petalled plants and flew over from one row of these to another, neglecting the apetalous plants growing in between.

Studies of the genetics of the apetalous character and its usefulness for practical breeding are in progress.

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Feb. 3.

[1] Sprague, G. F., *J. Hered.*, **30**, 143–45 (1939).

Relationship of *Gossypium Raimondii* Ulbr.

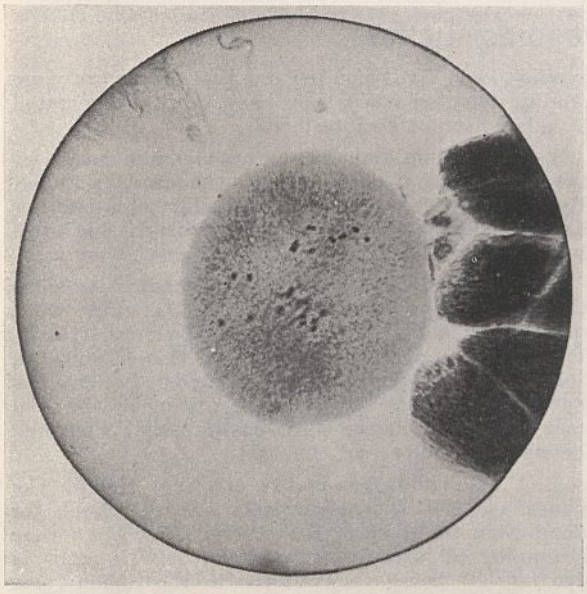
Two notes have recently appeared on the relationship of the wild Peruvian species of cotton *Gossypium Raimondii*, Ulbr.: Hutchinson[1] and Newcombe[2] simultaneously grouped *G. Raimondii* with $2n = 26$ wild New World cottons on somatic counts made by Madoo. They placed it in the sub-group *G. Koltzschianum*, Anderss, *G. Davidsonii*, Kellogg, which it undoubtedly resembles morphologically, the former adding hybridization behaviour.

At La Molina, the chromosome conjugation of *G. Raimondii* at meiosis has shown thirteen bivalents.

In a cross *G. hirsutum*, L. (*U*4) × *G. Raimondii* the meiotic chromosome conjugation shows a mean of 12·57 univalents, 11·65 bivalents, 0·87 trivalents, and 0·125 quadrivalents, and a chiasma frequency of 1·62 per bivalent.

From this data it is suggested that *G. Raimondii* is more closely related to *G. armourianum*, Kearney, *G. trilobum* (*DC*) Kearney, *G. Harknessii*, Brandg., and *G. aridum*, Skovsted, than to *G. Davidsonii*, Kellogg and *G. Klotzschianum*, Anderss.

The accompanying photomicrograph of the conjugation in the hybrid *G. hirsutum* × *G. Raimondii* shows twelve univalents and most of the bivalents.



× *c.* 1000.

A more detailed study is being put out as an official publication of La Molina Agricultural Experimental Station.

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[1] Hutchinson, J. B., *Trop. Agric.*, **16** (12), 271–272 (1939).
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Use of Adsorption Processes for the Detection of "Traces"

METHODS for the detection of a trace of a compound dissolved in water may be made very sensitive if that compound can be concentrated by adsorption at an interface. Thus an almost infinitesimal quantity of grease, adsorbed on a metal or mineral surface, is readily detected by its effect on the displacement of water from that surface by air[1]. Very sensitive tests for copper, lead and cyanide ions were also discovered in the course of an investigation of the basic principles of the flotation process. Though these are not specific, they seem worth recording in illustration of a method that may sometimes be useful.

When a mineral is polished out of contact with air, there is produced a surface from which air is unable to displace water[2]. A pyrite (FeS_2) surface prepared in this way becomes air-avid in a 25 mgm. per litre solution of potassium ethyl xanthate, as a bubble of air pressed against the surface will now adhere to it. One part of CN^- in 2×10^7 parts of water prevents this adhesion.

Sphalerite (ZnS), polished similarly, does not respond to this concentration of xanthate even in the absence of cyanide. However, if there is present 0·006 mgm. lead nitrate per litre as well as the xanthate, the surface does become air-avid, the lead ions acting as a link between the mineral surface and the xanthate ions. Likewise, 0·005 mgm. copper sulphate ($CuSO_4.5H_2O$) per litre induces air-avidity in the presence of sodium di-ethyl dithiocarbamate. Thus one part of lead in 3×10^8 parts of water and one part of copper in 8×10^8 parts of water are detectable. For copper the test is ten times as sensitive as the usual dithiocarbamate test[3].

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Jan. 11.

[1] Wark, I. W., "Principles of Flotation" (Melbourne, 1938).
[2] Wark, I. W., NATURE, **143**, 1024 (1939).
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Angle of Repose of Snow on Solids

IT is well known that the friction of solids on snow surfaces is larger than on ice surfaces. The higher kinetic friction obtained on snow is attributed to the extra work done in displacing and compressing the snow crystals[1]. This may apply to the sliding of a

ski or a sleigh on snow. It is, however, common experience that snow also while resting, for example, on the roof of a house or on a metal spade, exhibits a considerable angle of repose.

The extremely small friction of ice surfaces near the melting point is due to lubrication by water at the points of contact between the sliding surfaces. The porosity of snow hinders considerably the establishment of thick film lubrication by the melt. This is demonstrated by the following experiments. The angle of repose of snow and of snow compressed by hand was measured on various surfaces which were at room temperature (about 20° C.). The compressed snow always has the smaller angle of repose (see accompanying table). The 'loose' snow sticks on steel even at an angle of inclination of 90°, while the molten water rises in the snow 'capillaries'.

Base plate	Angle of repose		Coefficient of static friction	
	Loose snow	Compressed snow	Loose snow	Compressed snow
Smooth bakelite	16°	3°	0·29	0·05
Glass	19°	3°	0·34	0·05
Ferrotype	16°	7°	0·29	0·12
Steel	>90°	35°	∞	0·7

The blotting action of the snow, which leaves, in contradistinction to the non-porous ice, at first only a thin adhesive intermediary water film, particularly when melting proceeds more rapidly from the solid base (for example, steel) than from the surrounding air, might become more obvious in an experiment where melting is not involved. A small heap of silica powder flows from a dry glass plate at a small angle of inclination. Addition of a sufficiently small amount of water just to wet the sand heap cements its grains together and cements the sand heap to the glass plate. It sticks to it, even at an angle of inclination of 90°. However, an addition of water, in excess of saturating the sand heap with it, leads to thick film lubrication and makes the sand slide off the glass plate at a small angle of inclination.

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[1] Bowden, F. P., and Hughes, T. P., *Proc. Roy. Soc.*, A, **172**, 208 (1939).

Snowfall in the Winter of 1939-40

WHEREAS the great ice-storm which affected a large area in western and southern England on the night of January 27 has been stressed in the various reports which have hitherto appeared on the cold weather, the magnitude of the snowfall seems to have been under-estimated.

Apart from various other snowfalls, there occurred on the very night of the ice-storm an exceedingly heavy fall of dry drifting snow over the whole of south-eastern, eastern, midland and northern England, as well as most of Scotland. In Kent, the Chilterns and East Anglia, the fall on the level was commonly between 1 ft. and 2 ft., and many villages were isolated by huge drifts ; in Lancashire, Cheshire and the Lake District the general fall was between 2 ft. and 3 ft. The fall on the Lancashire coastal plain was apparently the heaviest since February 1900. It is possible, and indeed suspected, that part of the accumulation may have been due to mass drifting from the Pennine uplands to eastward.

The late Mr. Joseph Baxendell, formerly superintendent of the Southport Borough Observatory, has frequently of recent years written to me respecting the scarcity of serious snowfall in west Lancashire, and I cannot but regret that he was not spared quite long enough to see this mighty downfall of snow.

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Points from Foregoing Letters

THE method of isotopic indicators has been used by L. Hahn and G. Hevesy to determine the rate of turnover of nucleic acid extracted from various organs of rabbits. The rate of exchange is extremely low in the liver ; it is higher in the thymus and in the muscles.

L. F. Bates and J. C. Weston show that the coefficient of thermal expansion of invar may be determined by measuring the changes of temperature which occur when a rod is suddenly stretched and when it is taken through a hysteresis cycle.

It has previously been assumed that the linear relationship existing between the parachor and critical temperatures of chemically related substances is due to similarity of cohesive effect. D. T. Lewis finds that the slopes of these lines vary in a simple manner with the number of electrons in simple molecules which do not participate in the true 'valency bond', and this is put forward by him as evidence that these electrons play a large part in determining the magnitude of the cohesive forces between molecule and molecule.

K. L. Sutherland describes effects on mineral surfaces due to minute traces of copper, lead and cyanide ions. It is pointed out that traces are more readily detected when they have been concentrated by adsorption at an interface.

S. Ramanujam describes an apetalous mutation of the turnip, with $n = 10$, which is the normal number. By crossing with the normal petalled form, the author has shown that the apetalous character is heritable but recessive.

The kinetic friction of solids is higher on snow than on ice, partly on account of the extra work done in displacing and compressing the snow crystals. R. Schnurmann finds the static friction of snow on solids at room temperature still higher, because the porous snow dries up the water arising at the contact with the warmer base, leaving only a thin film between the snow and the base.

L. C. W. Bonacina points out that though the winter of 1939–40 was relatively less remarkable for snow than for frost in the British Isles, there were a number of heavy snowfalls, that of the night of January 27 being very intense in the region lying outside the area of the severe ice-storm and quite unusual in Lancashire.

RESEARCH ITEMS

Acadian French in Louisiana

Results of anthropometric measurements of one hundred young men of almost complete Acadian French ancestry, students of the Southwestern Louisiana Institute, were communicated by H. N. Gould of Tulane University to the Columbus, Ohio, meeting of the American Association for the Advancement of Science, December 27–29, 1939. The subjects were descendants of French settlers deported from Nova Scotia in 1755–60, and belong to a community which has maintained a high degree of cohesion and isolation. Their body measurements do not differ by more than three or four times their probable errors from the corresponding measurements of Old Americans measured by Hrdlička. Such differences as there are point to slightly smaller dimensions in the Louisianians in body, head and face. They are taller on the average than the American soldiers of French descent in the United States army (Davenport and Love). They are superior in height to males in France. In hair colour there are few true blondes, and almost 80 per cent have hair in the range dark brown and brown-black. Red hair is absent. The percentage of light eyes, in spite of the dark hair, is as great as in the Old Americans generally, and the percentage of pure brown eyes is greater. Mixed eyes of irregular blue and brown pattern are relatively less frequent. In so far as this sample is reliable, the Acadian Frenchman of Louisiana is physically "Americanized".

Melanophores of the Cat Fish

G. H. Parker, in a paper read before the Columbus meeting of the American Association, directs attention to the controversy on what constitutes the resting state of the melanophores of the cat fish. It has been customary to compare the colour cells and their nerve fibres with muscles and their motor nerves. Some have regarded the contracted melanophore as being in the active state, and have taken the expanded cell for resting. Others have assumed the reverse to be true, and still others have claimed that both expansion and contraction represent active states. Experiment has shown, however, that none of these hypotheses is correct. A blind cat fish in the dark has no inducement to alter its colour, and fishes from which the eyes had been removed at various stages of darkening remained indefinitely in the condition in which they were at the time when the operation was performed. He concludes, therefore, that all degrees of expansion and contraction are states of rest, and that a state of action is only in evidence when the melanophore is changing from one state to another. The comparison with *skeletal* muscle is, therefore, most inappropriate, and, if such a comparison must be made, it should be between the colour cell and the *smooth* muscle fibre.

Position of Thylacine or Tasmanian 'Wolf'

Fifty or sixty years ago the marsupial wolf (*Thylacinus cynocephalus*) was a common Tasmanian animal, feeding upon small marsupials and sheep. As a consequence of the destruction of the flocks of settlers, the Government of Tasmania paid up to £1 a head for its slaughter, with the result that it was exterminated in the neighbourhood of settlements and found safety only in the wild western parts of the island. The threat of extermination resulted in prohibition of the export of the animal and its complete protection in the island. Unfortunately a new roadway linking Hobart with Queenstown has penetrated the wild country where the Thylacine appears to be making its last stand, and this adds a new threat to its survival. In order to estimate the present-day position of this rare creature, surveys of its territory have been made, and in one part it is reported from observation of tracks that "it was not unreasonable to estimate that the district contained as many as half a dozen pairs". M. R. S. Sharland considers that the creation of a sanctuary adjacent to the West Coast Road, including some 300,000 acres of land of varied character unsuitable for agricultural development, would best meet the needs of the Thylacine and other mammals (*Proc. Roy. Zoo. Soc. N.S.W.*, **20**; 1938–9).

Black and the Striped Marlin

A detailed account of measurements and external features of these gigantic fishes is given by William K. Gregory and G. Miles Conrad (*Bull. Amer. Mus. Nat. Hist.*, **76**; 1939). Microscopic examination of the gonads proves that there is little or no difference in external body form between the sexes of the black marlin, both male and female having been secured. A summary of the characters of the body-forms of the striped marlin, *M. mitsukurii*, the Atlantic blue marlin, *M. nigricans ampla*, and the Pacific black marlin, *M. nigricans marlina*, shows that although there is intergradation in all features of the body-form, there are proportional tendencies which when considered in groups serve to aid in separating them. They are generally easily distinguished by colour and other qualitative differences upon gross examination. The black marlin differs from the striped and the blue marlin in the fact that the pectoral fin, when adducted, remains in the horizontal position, whilst in the others it can be brought up flat against the side of the body.

Effect of Rubbing on Leaf Respiration

L. J. Audus has now extended his earlier observations upon cherry laurel leaves to cover a fairly wide series of leaf types, and in almost all cases has found a well-marked increase in the rate of evolution of carbon dioxide as the result of gentle rubbing of the leaf tissues (*New Phyt.*, **38**, 284; 1939). In the case of softer mesomorphic leaves, they were held between the thumb and forefinger and then gently bent in different directions. Treatments which produced no visible damage were sufficient to produce a very marked increase in respiration. These results obviously have very considerable significance in connexion with many experimental investigations in which isolated leaves have been used and, necessarily in many cases, handled freely during the setting up of the experiment. They recall the earlier observations of J. M. Janse upon the marked effects produced upon the further growth of the roots of seedlings by a very slight amount of handling (*Proc. Koninkl. Akad. van Wetensch te Amsterdam*, **29**, 834; 1926).

Maize Breeding

J. PHILP (*Bull.* 202, Min. Agric., Egypt) has shown that the F_1 of the inbred lines of maize derived originally from America and from native sources shows increased yields up to 27 per cent above the parental lines. The practical problems pertaining to Egypt's conditions are discussed, and it would seem that a great improvement in the crop yield is possible by this method.

Raspberry Mosaic

R. V. HARRIS (*J. Pom. and Hort. Sci.*, 17, 318; 1940) describes experiments in which mosaic disease was transmitted from nine varieties of European red raspberry and one American variety (Bath's Perfection) to the European variety Baumforth's *B*. All attempts to transmit the disease by mechanical means, such as injection with juice from infected canes, failed, but successful transmission was achieved by several different kinds of grafting. The symptoms induced in the test variety were in all cases recognizable as one of two distinct types, or as a combination of the two. They are ascribed to two different virus groups referred to as mosaic 1 and mosaic 2. Mosaic 1 always produced mild leaf symptoms of the same type, from whatever variety the infection was derived. It produced similar symptoms on two other varieties, Lloyd George and Reader's Perfection. These features are characteristic of a simple disease due to a single virus with a comparatively limited varietal distribution. Mosaic 2 comprises two or more diseases inducing leaf symptoms which are identical, but varying in severity from mild to very severe. Different varieties varied widely in susceptibility to mosaic 2, and masking of symptoms occurred on some varieties. In one case, Lloyd George, leaf symptoms were entirely absent from artificially infected canes, whilst with Preussen and Red Cross, symptoms were suppressed for a season, or limited to single leaves or canes. It is noted that great similarity occurs between mosaic 1 and mosaic 2, and the American diseases yellow mosaic and green mottle mosaic respectively.

Rocks of Mount Everest

IN the Records of the Geological Survey of India, 1939, pp. 171–188, L. R. Wager gives an interesting account of the Lachi Series of North Sikkim and the age of the rocks forming Mt. Everest. From Everest to North Sikkim a thick comformable series of sediments lying below the Jurassic and Cretaceous rocks of the Tibetan plateau, and often much metamorphosed and injected by granite, has now been distinguished and in part mapped. First there is the Tso Lhamo series, with fossils indicating a Triassic age. Below them is the Lachi series, an upper horizon of which contains an Upper Permian brachiopod fauna. Below this again is the Mount Everest limestone series of Carboniferous or Permo-Carboniferous age. These calcareous sediments form the actual summits of Mt. Everest and of several surrounding peaks. Towards the base of the series the limestone becomes more pelitic and is much metamorphosed by thick sheets of granite and granite-gneiss. The underlying rocks, though much injected by granite with formation of banded gneiss, are shown to consist of about 4,000 feet of dominantly pelitic sediments called the Mount Everest pelitic series. No fossils have yet been found in these rocks, but since they lie conformably below the Mount Everest limestone series they are probably of Upper Palæozoic age. It is clear that in the eastern Himalaya sedimentation in the Tethys geosyncline began early—probably in or before Carboniferous times—and continued with no serious interruption until the Eocene.

Mechanism of Wurtz Syntheses

THE study of some condensation reactions by sodium (A. V. Morton, J. T. Massengale and G. M. Richardson, *J. Amer. Chem. Soc.*, 62, 120, 123, 126, 129; 1940) leads to the view that the Wurtz product, the dimer, is reached by way of an intermediate organometallic compound, for example, benzylidene disodium and benzyl sodium, there being no need to postulate any other special mechanism, although it is possible to superimpose on this view an ionic mechanism (organosodium compounds are salts) or a free radical mechanism, and side reactions and decompositions may occur. Assumption of an intermediate free radical provides at present a convenient explanation for some of the products. In the experiments it is shown, for example, that no decane is formed prior to the formation of amylsodium in the reaction between amyl chloride with sodium, the amylsodium then reacting with addition of amyl chloride. Ortho-phenyldiphenyl and diphenyl are not metallated by phenylsodium but are by amylsodium. Several other reactions are described in the papers.

Criteria of Moving Star Clusters

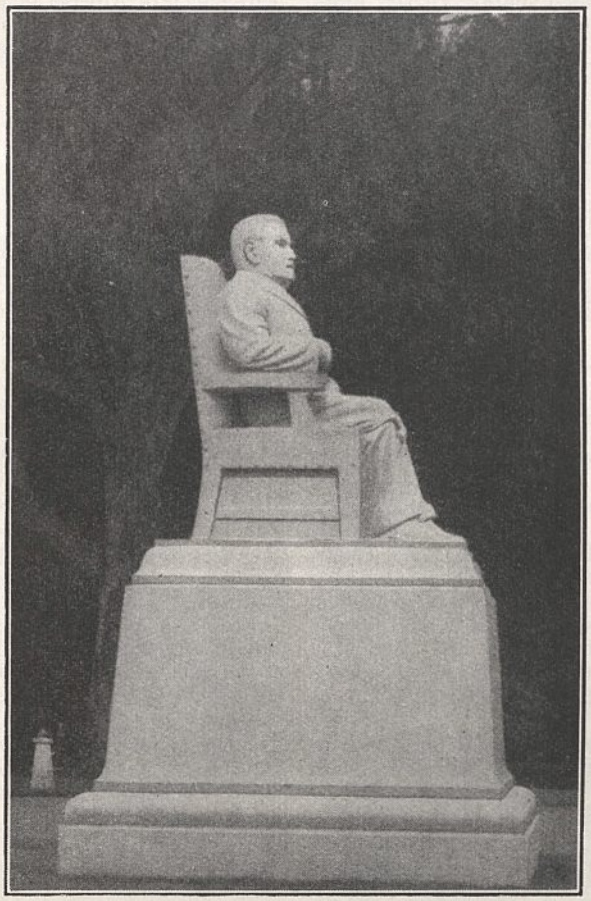
W. M. SMART has published a paper entitled "The Scorpio-Centaurus Cluster (The Southern Stream)", which disproves a view held for about a quarter of a century on a number of *B*-type stars, lying between galactic longitudes 210° and 330°, forming a moving cluster (*Mon. Not. Roy. Astro. Soc.*, 100, 2; December 1939). If the Southern Stream is a real moving cluster, it should be possible to apply other criteria than those previously used to substantiate the hypothesis. Smart's procedure is similar to that adopted in an earlier paper (*Mon. Not.*, 441; 1939). One very important result of the method is the determination, for each star of the so-called stream, of its own appropriate value of K, assuming that the existence of the stream is established. Rasmuson's list of 160 stars is used as the basis of the calculation in deriving the position of the convergent point; the equatorial co-ordinates of this (91°–37°) are close to the solar antapex. The stream velocity is derived by means of the observed total proper motions and spectroscopic parallaxes on the assumption that the stars form a moving cluster, and is found to be 18·8 km./sec. The application of the absolute magnitude criterion shows that the results are not hostile to the assumption of the stars in Rasmuson's list belonging to a moving stream, but are on the whole inconclusive regarding the constitution of the cluster. With the above stream velocity, the calculated radial velocity of each star is compared with the observed radial velocity, and if the stars move in a cluster the difference should theoretically be the K term. The result of the investigation is conclusive against the view that the stars under discussion form a moving cluster. In fact, the 'stream-velocity' is simply the solar velocity, and the 'convergent point' is the position of the solar apex.

MEMORIAL TO SIR ARNOLD THEILER

SIR ARNOLD THEILER, founder and first director of the Veterinary Research Institute at Onderstepoort, near Pretoria, South Africa, died in London on July 25, 1936. His great services to veterinary science were widely recognized during his lifetime and many rewards and honours were showered on him. He received no less than seven honorary doctorates. Of other great distinctions may be mentioned his election to the Paris Academy of Sciences, the award of the Laveran Gold Medal, the Budapest Gold Medal, and the Gold Medal of the Royal Agricultural Society of England. He was an honorary or corresponding member of some twenty scientific societies.

After his death the country of his adoption bestowed an even greater honour on him than any he had received during his life. The Government of South Africa decided to erect a monument to his honour at the institute which he had founded

On Wednesday, November 15, 1939, before a large and distinguished gathering, including the members of the Diplomatic Corps, Cabinet Ministers, heads of Government Departments, many scientific workers and other prominent citizens, General the Right Hon. J. C. Smuts, Prime Minister of the Union of South Africa and a personal friend of Sir Arnold Theiler, unveiled the statue. "To-day," said General Smuts, "is not a day of mourning, it is one of rejoicing. We have come to honour the memory of one of the foremost men in the history of science in South Africa. We are filled with a spirit of rejoicing and appreciation.



STATUE OF THE LATE SIR ARNOLD THEILER, AT THE VETERINARY RESEARCH INSTITUTE, ONDERSTEPOORT.

"There are some special features about the occasion. Firstly, this is the only occasion on which a monument has been erected to a great man in the Union by the South African Government. Hitherto we have always left it to friends and admirers to collect funds for a memorial, but Sir Arnold seemed to this Government and the previous Government to be an outstanding case where an exception should be made. He had done such great service that we felt we were justified in erecting a memorial on behalf of the entire nation instead of merely of a group."

Secondly, said General Smuts, South Africans had been prone to honour men who had held high public posts in their country—statesmen, soldiers and outstanding public men. Sir Arnold, however, had not been in the public eye, he had not occupied a high position. He had been a man of science pure and simple, and had belonged to a branch of science which had no high honour attached to it—veterinary science. "But," continued General Smuts, "this veterinary doctor made himself, this institute, this country famous all over the world. More than any other man he has put South Africa on the science map of the world."

General Smuts touched on the history of Theiler. He mentioned how General Botha had encouraged the young Swiss veterinarian and how, realizing the vast importance of scientific work, he had sponsored the grant for the erection of the institute at Onderstepoort.

"There are many young men to-day who must have a vivid recollection of Sir Arnold Theiler's great personality. He was sincere, straight, powerful, enthusiastic, devoted to his work. Many books have been written on his scientific discoveries. There is not an animal disease of any importance which he did not tackle. Every time he found out the cause, the source and nearly always the cure. He worked on such scourges as east coast fever, red-water fever, horse-sickness and blue-tongue. And when we realize how seriously these diseases have retarded our progress in the past, we understand what a benefactor he was.

"It was not hard work alone which took Sir Arnold to the heights ; he possessed that added something possessed by so few, 'the genius of insight'. And yet, in spite of his greatness, he was a simple soul ; he lived and worked for his profession.

"We should be proud of this institute of Onderstepoort which he built up," said the Prime Minister. "The men here merely do their jobs. They are not politicians and I hope they never will be. They are here to carry on the scientific tradition of devotion to duty which he began."

The statue, made in granite quarried near Pretoria, was sculptured by Mr. Coert Steynberg.

RECENT RESEARCHES IN AMERICAN ARCHÆOLOGY

AMONG numerous evidences of increased interest in the United States of America in the antiquities of the continent and the origin, character and cultures of its earlier inhabitants is the fact that research in branches of study bearing upon such problems is no longer confined mainly to the more influential and populous intellectual centres, with their widely known and strongly supported universities, museums and other learned bodies. Local research, and even investigations implicating extended ramifications, are now appearing with regularity in the departmental studies of universities and academic institutions in the outlying and remoter States. Financial support, however, at least so far as concerns investigation in the field, is not always readily to be obtained, and various economies have to be practised. If these affect publication, as indeed frequently happens, results of importance may be overlooked, especially in Great Britain, where, unfortunately, it is sometimes difficult for archæologists to keep fully abreast with the progress of such research in America. Owing, however, to the financial limitations to which reference has been made, an index to activity in research, naturally not in archæology only, which alone is under consideration here, is afforded by the reports of bodies administering the various funds, to which scientific research in America is in the fortunate position of being able to look for support. Among such bodies, the American Philosophical Society takes a prominent place, owing to the value of the funds under its control, while the accounts of the researches it subsidizes which appear in the Year Book*, brief as they are, are a valuable guide to the trend of scientific investigation in widely extended fields throughout the academic world of the United States.

From this point of view, the following notes on recent archæological investigations, extracted from reports in the Year Book, will be of interest.

The discovery of characteristic stone artefacts attesting the existence of an early and primitive hunting people, who from the association of their relics, it is evident, were contemporary with a fauna pleistocene in character and now extinct—a people to whom the distinguishing name of Folsom man is assigned—has naturally given rise to inquiry as to how and by which route this culture and other cultures, apparently even earlier in time, reached the south-western States, the region of their discovery. The hypothesis that their penetration of the south-west was from the north, and took place in the Pleistocene age, by way of an ice-free corridor, has naturally stimulated investigation with the view of finding traces of the distinctive culture of Folsom man in the more northerly regions of the continent. The search has not been without result, notably in the work of Dr. F. H. H. Roberts in Canada. An investigation on similar lines was undertaken by Wesley L. Bliss, of the University of New Mexico, by whom an archæological and geological reconnaissance has been carried out in Alberta, the Mackenzie Valley, and on the Upper Yukon, with the financial assistance of the American Philosophical Society.

In the preliminary report the purpose of the investigation is stated to be "to tie in, if possible, early cultural and culture complexes in relation to glacial chronology". It followed on investigations already carried out in 1937 with the co-operation of the University of Alberta in which Yuma points, belonging to a south-western culture related to the Folsom culture, were located in eastern Alberta, and cultural affinities and contacts were demonstrated with British Columbia and Wyoming or the west coast, while abalone shell-pendants indicated connexions with the Californian coast. In the following season, geological investigations showed that all the area covered by the expedition along the Sikanni, Nelson and Liard Rivers of the Mackenzie River basin had been glaciated by Keewatin ice. Evidence of cave occupation by man was found near Blue Fish Lake, north of the Nahanni Butte, where ash layers overlay the blue clay deposited during glaciation, while information was obtained of smoke-darkened walls in two others. Search for evidence of man below the clay, which would prove human priority to the Keewatin advance of the ice in this region, is obviously desirable. The existence of an ice-free corridor from Bering Straits eastward to the Mackenzie delta was inferred from the absence of any evidence of glaciation in the valley of the Little Bell River, a tributary of the Yukon. Near Neon Lake, at the top of the pass, two terraces above the lake yielded artefacts comparable to the Pleistocene Lake Mohave artefacts of California and closely resembling those from the lowest cultural stratum of Borax Lake, California, which antedate the Folsom culture.

On returning to Alberta, field work was resumed, and four Yuma sites were found near Cereal, and two Folsom sites examined in western Saskatchewan. Of these, one near Mortlach is situated on the Altamont moraine and definitely dates Folsom as post-Wisconsin. An isolated flaked microlithic point from eastern Alberta is identical with points from the campus of the University of Alberta and also with those of the dune dwellers of Gobi in Central Asia.

Geographical conditions show that the great river basins of the north-west were more probable routes of migration from Asia than the rugged Alaskan and British Columbian coasts. Mapping of the Illinoian and Wisconsin moraines indicates an open corridor between the mountains and the continental glaciers in these periods.

Prior to this reconnaissance, nothing was known archæologically of the regions covered.

Recent archæological surveys of the south-western United States have been directed to the classification of the cultures found on occupation sites. Of the four basic cultures recognized, little is known by excavation of the Patayan culture, which centres in the Colorado River valley below Boulder Dam. In fact, north-western Arizona, to which this culture belongs, has been a blank place on the archæological map.

In the summer of 1938, an expedition of the Museum of Northern Arizona under Lyndon L. Hargrave, field director of the Museum, with the assistance of a generous grant from the Penrose

* The American Philosophical Society. Year Book, 1938. Pp. 407. Philadelphia: American Philosophical Society, 1939.)

Fund, made an intensive study of sub-cultures of the Patayan culture, excavating a site seven miles north of Williams, Arizona, which consisted of a large masonry fort and seventeen earth lodge sites. A preliminary conclusion, pending further analyses, establishes the existence of the Cohonina Branch of the Patayan culture, differing essentially from the Hohokam of the south and the Pueblo to the east. A relationship to the people of the Colorado to the west is suggested.

The Cohonina lived a semi-sedentary life, part agricultural, part food-gathering. Their homes were surface structures built of perishable material, earth lodges, of which the detailed architecture is difficult to trace. Much charcoal was collected, which, however, has as yet yielded no dendrochronological evidence. Ceramic types date occupation at about A.D. 700 and A.D. 1100, the fort with its massive masonry belonging to the later period of occupation. A special projectile point was used to which the name "Cohonina point" has been given. Few ornaments were used, none of shell. The pottery belongs to the San Francisco mountain gray ware; and from its distribution it is possible to fix the extension of the Cohonina Branch—the area between the Little Colorado River on the east and the escarpment of the plateau on the west, and from the Grand Canyon on the north to the San Francisco volcanic field in the south.

An investigation of primitive Indian agriculture in the south-west by Edward F. Castetter, of the University of New Mexico, throws light on the crops grown anciently in this region. A preliminary survey was made of the technique, crops and implements among Mohave, Yuma, Cocopa, Maricopa, Papago, Pima, and a number of Pueblo groups. The ancient crops were maize, beans, pumpkins, cotton, tobacco and gourd. In addition, the Colorado River tribes sowed several species of grasses. The Pueblo peoples had a much greater variety of corn and beans than the peoples of the Gila and Colorado Rivers, who had only four—yellow, blue, white and speckled, all corn of the flour type. The pumpkins were *Cucurbita moschata*. It was found that agriculture could not be investigated adequately without knowledge of ritual, the two being inseparable; but it was difficult to obtain information owing to the secrecy of the Indians, especially the Pueblo, on such matters.

BIOLOGY AND SYSTEMATICS OF THE SARGASSUM WEED

MATERIAL for research on the floating Sargassum vegetation of the western North Atlantic was collected in connexion with a series of hydrographic cruises to the central American seas on the research ship *Atlantis*, sponsored jointly by the Woods Hole Oceanographic Institution and by Yale University (under the auspices of the Bingham Oceanographic Foundation), a special surface net being used which was designed to gather floating weeds from the sea surface on a quantitative basis, and the results of the researches have now been published*.

This net has been in actual operation on the surface of the Sargasso Sea and of the central American seas for a total cumulative towing length of nearly 7,000 nautical miles, and as a result of this towing more than 4,700 pounds of pelagic weeds have been sorted and weighed on board. Experimental evidence shows that these weeds do not occur in any quantity at any significant distance below the surface.

In the taxonomic discussion a key is given for the identification of the main types of floating Sargassum weed, illustrated by a number of silhouettes. The author concludes that the fixed, more or less distinct, external forms in which the truly pelagic weeds occur represent only phenotypic variations of not more than two separate species, *S. natans* and *S. fluitans*. Even the distinctness of these two species, although probable, is not established entirely without doubt.

The quantitative estimates show that floating weed is scarce in the Caribbean and Cayman Seas and practically absent from the entire southern half of the Caribbean itself, whilst in the north-western region of the Gulf of Mexico a secondary accumulation of apparently deteriorating weeds in considerable abundance was observed over a wide area. The chief region for thriving pelagic weeds was entirely outside the central American seas in that part of the North Atlantic designated as the Sargasso Sea.

The distribution, as shown in these results, confirms the previous hydrographic conclusions, that the failure of the drifting flora to penetrate northward across the Caribbean agrees with the assumption that the Caribbean surface water is mainly derived from the south-east via the north equatorial current and not from the Sargasso Sea itself. The accumulation of floating weed in the north-western part of the Gulf of Mexico must be interpreted as a result of pure wind drift, due to prevailing easterly winds moving the weeds in relation to the water; this accumulation could scarcely take place in the presence of a significant tendency to outward movement of the surface water towards the Straits of Florida.

Up to the present time, no benthonic fixed stage is known of the two species *S. natans* and *S. fluitans*, and it has been a controversial subject as to whether these weeds grow vegetatively to any great extent in the floating state. Recent authorities increasingly favour the theory that such growth does take place, and the present work shows conclusively that these weeds grow and prosper for years without any sexual reproduction; and further, there can be no conceivable source and process of annual renewal of pelagic Sargassum vegetation from benthonic flora which could possibly maintain the floating vegetation in its observed abundance with an average duration of the pelagic state of the individual plants to be reckoned in less than decades. One fertile plant attached to a drifting piece of wood was obtained which was otherwise indistinguishable from sterile representatives of the pelagic *S. fluitans*, the only

* "Quantitative Observations on the Pelagic Sargassum Vegetation of the Western North Atlantic. With Preliminary Discussion of Morphology and Relationships". By Albert Eide Parr. *Bull. Bingham Oceanographic Collection*, Peabody Museum of Natural History, Yale University, **6**, Art. 7. Dec. 1939.

one ever found and of great importance in showing the form of the sexual phase, as it will now be possible to search for a known fixed form.

It is thus firmly maintained, supporting Winge (1923) and others, that "the pelagic *Sargassum* of the Sargasso Sea, apart from its marginal zones, is probably an essentially self-sustaining unit with a potentially infinite longevity and a very long normal expectancy of life for its individual plants, receiving (at most) only a very slight annual contribution from benthonic vegetation merely sufficient to compensate for its own loss by a slight excess of mortality over vegetative growth increment, suffered mainly through a continually occurring chance return of some of its members to the dangerous marginal zones from which a corresponding recruitment of freshly detached plants which have escaped its hazards are received in exchange."

The significant fact remains that no fixed benthonic stage is yet known of either of the two predominant types of floating Sargassum weed of the Sargasso Sea, namely, *S. natans* and *S. fluitans*. It seems that it must be concluded that here we have an essentially self-sustaining community of plants in which the pelagic existence has become secondarily normal, and which are able to maintain and multiply themselves indefinitely by mere vegetative growth, mechanical fragmentation and irregular partition of the individuals through disintegration from the basal end.

RECENT AMERICAN INVESTIGATIONS IN EMBRYOLOGY

AN interesting paper of practical importance in orthopædic practice, entitled "The Functional Results of Muscle Transposition in the Hind Limb of the Rat", was read by Prof. R. W. Sperry at the Columbus Meeting of the American Association last December. The muscles operating the hind foot of this animal were transplanted in reverse, with the result that both reflex and voluntary movements of the hind limb were also reversed. Motion pictures showed that even after a year's trial of the new arrangement, there was no adjustment, and although the muscles worked the limb, the motor nerve patterns for limb co-ordination were on the old basis. Unfortunately the author does not state the names or number of the transplants.

Papers on experimental embryology related to the early development of the sea urchin, *Arbacia punctulata*. Profs. W. C. Allee and Asher J. Finkel, starting from the observed acceleration in cleavage-rate due to density of egg population and suspecting that some growth-promoting substance was responsible, carried out a series of experiments at Woods Hole with the intention of finding out more about the stimulating factor. They did not succeed in determining the chemical nature of the substance or substances; but their experiments showed that an extract from *Arbacia* eggs, even in "extremely dilute concentrations, can accelerate the early development of *Arbacia* eggs to a significant degree over that of untreated but otherwise similar eggs". They suggest that "undercrowding is as real in its effects as overcrowding".

Miss Ethel Browne Harvey studied the role of the nucleus and the cytoplasm in *Arbacia* eggs. Unfertilized eggs, broken into half eggs by centrifugal force, give a nucleated and a non-nucleated half. Both halves can be fertilized, or activated artificially. In the former case two plutei are produced; in the latter, the nucleated half becomes a pluteus, the non-nucleated half a blastula only. Fertilized eggs behave differently. A half containing both pronuclei forms a blastula, or at most a defective pluteus. A non-nucleated half, although its cytoplasm is affected by fertilization, does not even cleave, but the cytoplasm may make an attempt to produce asters.

The author calls the development of the non-nucleated half of the artificially activated but unfertilized egg "parthenogenetic merogony". But since this half develops to the blastula stage only, it would appear that a nucleus is essential for the *differentiation* of the cells, though not for their mere multiplication.

Prof. Robert Chambers and E. L. Chambers found that fertilization of the egg in *Arbacia* could be arrested by immersing the egg immediately after insemination in a solution of potassium chloride, the strength of which is not stated. The return of the eggs so treated to normal sea-water more than an hour later causes resumption of activity of the sperm and subsequent normal development.

Two papers on transplantation of embryonic limb buds in birds were read by Prof. H. L. Eastlick. In the first set of experiments the chick embryo was the host, and duck, chukar partridge, quail, guinea fowl and turkey were the donors of the grafts. Both leg and wing were employed, transplantation being effected on embryos two to three days old. The egg was then re-sealed and put back in the incubator for further development. Fifteen per cent of the embryos hatched with the graft as a fifth limb. These grafts retained the structural characters of the donor species, except in a few cases where a partial merging of skin characters of donor and host occurred. Thus a duck leg graft formed a webbed foot, the feathers of which failed to develop after a poor attempt to do so; they were followed by a second growth of host feathers. In other cases the graft limb grew at first but was later resorbed.

According to a second paper the birds mentioned above were used as hosts, but did not prove as successful for this purpose as the chick. Although the graft retained many of the characters of the parent bird, the age and extent of the graft affected the result. In particular, a graft removed with a portion of the neural crest developed feathers of the same colour as the graft's parent, whereas a graft cut laterally so as not to include the neural crest partook of the colour characters of the host. Grafts from white silky bantams, the feathers of which have no hooklets on the barbules, retained this character when transplanted to White Leghorn or Barred Plymouth Rock hosts. Prof. Eastlick described and illustrated some of his results in a brief communication published in NATURE of August 26, 1939, p. 380.

ROAD RESEARCH

THE work of the Road Research Laboratory during the year ended March 31, 1939, is described in the annual report now obtainable*.

An important event recorded is the enlargement of the site of the Laboratory by sixteen acres, which has made possible the construction of a special skidding track 2,000 ft. long, providing facilities for investigating the causes of skidding under more favourable conditions than exist on the roads and forming a useful calibration surface for the several machines used by the Laboratory and by the Ministry of Transport. A notable feature of the report is its indication of the way in which the research work is now evolving from the purely laboratory stage into the large-scale practical demonstrations of the road engineer. Examples of this development which are to be found in the report include the full-scale tests on the use of acid to reduce the slipperiness of smooth concrete surfaces, the treatment by chemicals of ice-bound concrete surfaces and durability tests on bituminous and asphaltic binders. In co-operation with the Timber Development Association extensive practical trials are proceeding with the view of improving the skidding resistance of wood-block surfaces, while other large-scale investigations have led to a better design of cast-iron surfacing by which the sideway force coefficient has been increased from about 0·25 to 0·45.

Soil mechanics in several important aspects continues to be developed, and experience of soil surveys undertaken in conjunction with the Ministry of Transport prior to the building of experimental roads has confirmed the view that useful and often essential information can be obtained in this way. As knowledge of subsoil conditions accumulates, it is reasonable to expect that the value of such soil surveys, preliminary to construction, will become progressively greater. The principal addition to the equipment of the Soil Mechanics Laboratory during the year has been an apparatus for obtaining undisturbed samples of soil, which operates a sampling tool by means of a double-acting hydraulic ram. After a hole has been drilled in the ground to the required depth, the tool is lowered into position and pressed home by the 10-ton ram. Incorporated in the tool-head is a relief valve which permits air or water to be expelled. The samples are tested in a new type of consolidation machine which also has been designed and constructed at the Road Research Laboratory during the year. An illustration shows a machine of a simple lever-loading type in which the specimen is held rigidly against a steel ball, the deformation being indicated on a dial gauge. In this department of the work, standard tests are being developed and the mechanical and physical properties of soils are being investigated, particularly in relation to the shrinkage of stabilized soils and the principles of soil compaction.

As already indicated, road surfacings receive a large share of attention. The report gives further details of the system of recording progressive changes in roads by means of the recently developed surface texture prints. These, as described in NATURE of January 6, p. 40, are a form of offset prints made on sheets of paper by means of a printing roller run over a small area of the road surface.

* Report of the Road Research Laboratory. (H.M. Stationery Office. 3*s*. 6*d*. net.)

SEVENTY YEARS AGO

NATURE, vol. 1, April 7, 1870

Natural Science at Cambridge

WE have heard so much recently of the long-delayed determination of Cambridge University to apply itself in earnest to the cultivation of Natural Science, that the information in the following paragraph must be a blow to those of its friends who hoped to see that it was entering on a new course: "The Syndicate appointed to consider the means of raising the necessary funds for establishing a Professor and a Demonstrator of Experimental Physics, and for providing buildings and apparatus . . . have made a report to the Senate, in which they state that they have addressed a communication to the several colleges of the University, to inquire whether they would be willing . . . to make contributions from their corporate funds for the above-mentioned objects. The answers of the several colleges, except that of King's, which has not yet been received . . . indicated such a want of concurrence in any proposal to raise contributions from the corporate funds of colleges, by any kind of direct taxation, that the Syndicate felt obliged to abandon the motion. . . . They confined their attention, therefore, to the means of raising sufficient funds only for carrying out the recommendations of the Physical Science Syndicate in their report dated Feb. 27, 1869. These were to provide the stipends of a Professor of Experimental Physics, of a Demonstrator and an attendant, requiring altogether a sum of 660 *l*. per annum; also to provide a capital sum of 5000 *l*. for a new building, and 1300 *l*. for apparatus. The Syndicate are of opinion that these sums may be raised from the ordinary sources of revenue of the University."

The Rotundity of the Earth

A RECENT number of the *Field* contains an account of a very amusing investigation which has been recently conducted on the Bedford Level to settle the question whether the earth is a globe or not! It appears that a Mr. Hampden threw out a challenge by which he offered to pay 500 *l*. to anyone who would prove the rotundity, which challenge has been taken up by Mr. A. R. Wallace, who has lodged a similar sum with the Editor of the *Field*. To test this point, six miles of the Bedford Level were used, three signals, each 13 feet 4 inches above the water level, being put up three miles apart. Mr. Wallace asserted that if he were correct the central signal would appear elevated about 5 feet above the line joining the other two; Mr. Hampden holding, of course, that they would all be in the same straight line.

Although the diagrams of what was seen by the telescopes used at both ends, and acknowledged to be correct by Mr. Hampden and his associate, show the central signal more than 5 feet above the line of the two extremes, "these gentlemen coolly claim the victory, and threaten to bring an action against the Editor of the *Field* (who was appointed umpire by Mr. Hampden himself) for fraudently deciding against them."

WE hear from Edinburgh that there is much excitement amongst the supporters of the Lady Medical Students, on account of the Professor of Chemistry refusing to accord one of the Hope Scholarships to Miss Edith Pechley, who, by the number of marks gained, is entitled to a junior scholarship.

FORTHCOMING EVENTS

[*Meetings marked with an asterisk are open to the public.*]

Tuesday, April 9

CHADWICK LECTURE (at the Royal Society of Tropical Medicine and Hygiene), at 2.30 p.m.—William H. Hamlyn: "Camps, their Design, Construction and Hygienic Arrangement" (Bossom Gift Lecture).*

ZOOLOGICAL SOCIETY OF LONDON, at 5 p.m.—David Lack: "Evolutionary Problems of the Galapagos Finches", together with a Film "Animal Life of the Galapagos". William Holmes: "The Colour Changes and Colour Patterns of *Sepia officinalis* L."

ROYAL PHOTOGRAPHIC SOCIETY, at 7 p.m.—W. W. Nicholas: "Bird Watching with Still and Cine Camera".

PHARMACEUTICAL SOCIETY, at 7.30 p.m.—Dr. C. H. Hampshire: "Pharmacopoeia Revision".

Thursday, April 11

LINNEAN SOCIETY OF LONDON, at 5 p.m.—General Meeting.

At 5.25 p.m.—(Joint Meeting with the Association for the Study of Systematics in relation to General Biology): A Symposium on Phylogeny and Taxonomy. (Speakers: J. S. L. Gilmour, Dr. O. W. Richards, Dr. T. A. Sprague, Dr. E. I. White.)

COUNCIL FOR EDUCATION IN WORLD CITIZENSHIP (at Somerville College, Oxford), at 8.15 p.m.—Dr. Gilbert Murray: "World Citizenship, the Growth of an Idea" (Inaugural Address).*

Friday, April 12

ROYAL AERONAUTICAL SOCIETY (at the Institution of Electrical Engineers), at 6.30 p.m.—Sir Alan Cobham and Marcus Langley: "Flight Refuelling".

SOCIETY OF CHEMICAL INDUSTRY (Joint Meeting of the Chemical Engineering Group and the Food Group), at 8 p.m.—T. W. Jones: "Chemical Engineering Problems in the Canning Industry", followed by a general discussion. (Speakers: Osman Jones and F. D. Farrow.)

APPOINTMENTS VACANT

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

TEMPORARY PATHOLOGIST—The Secretary, Hospital for Consumption, Brompton, S.W.3 (April 10).

CHEMIST AND BACTERIOLOGIST—The Water Engineer, 70 Park Lane, Croydon (April 12).

TECHNICAL ASSISTANT in the County Land Drainage Officer's Department—The Clerk to the Essex County Council, County Hall, Chelmsford (April 13).

COUNTY LIBRARIAN—The Education Officer, County Hall, Wakefield (April 15).

WOMAN to organize and give instruction in HORTICULTURAL and AGRICULTURAL SUBJECTS OF DOMESTIC ECONOMY—The Clerk of the Cambridgeshire County Council, Shire Hall, Cambridge (April 15).

EXPERIMENTAL ASSISTANTS (FEMALE) AT THE MINISTRY OF SUPPLY—The Secretary (S.E.3b), Ministry of Supply, Adelphi, W.C.2 (quoting Appts. 024/SE.3b) (April 16).

WORKSHOP INSTRUCTOR AND LECTURER IN PRODUCTION ENGINEERING at the Kenrick Technical College—The Director of Education, Education Offices, Highfields, West Bromwich (April 19).

ORGANIZER for Schools Service (female)—The Director, Museum and Art Gallery, Leicester (April 20).

ASSISTANT LIVESTOCK EXPERT for Animal Husbandry Work in Bengal—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 9/2A) (April 27).

LECTURER (GRADE III) IN THE DEPARTMENT OF ZOOLOGY—The Acting Secretary of University Court, University, Glasgow (April 30).

LECTURER (GRADE IIb) IN THE DEPARTMENT OF APPLIED PHYSICS—The Acting Secretary of University Court, University, Glasgow (April 30).

PRINCIPAL of the Ceylon University College—The Director of Recruitment (Colonial Service), Colonial Office, 29 Queen Anne's Gate, S.W.1 (April 30).

ASSISTANT MECHANICAL ENGINEER for the Tanganyika Government Railway—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9193).

EXECUTIVE ENGINEER for the Public Works Department, Government of Trinidad—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9197).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

British Non-Ferrous Metals Research Association. Research Reports, Association Series, No. 524: Quantitative Spectrographic Analysis with the Microphotometer. Part 1: A Review of Published Work. By D. M. Smith. Pp. 24. (London: British Non-Ferrous Metals Research Association.) 2*s*. [153

Report on the Phenological Observations in the British Isles from December 1938 to November 1939. By Major H. C. Gunton. (No. 49.) (*Quarterly Journal of the Royal Meteorological Society*, No. 284, Vol. 66.) Pp. 95–142. (London: Royal Meteorological Society.) 3*s*. [183

University of Birmingham. Report of the Vice-Chancellor and Principal to the Council, for the Thirty-ninth Session, 1938–39. Pp. 32. (Birmingham: University of Birmingham.) [193

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 1, No. 2: The Maximal Range of Error in Gross Reproduction Rates. By Dr. Enid Charles. Pp. 18–32. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 1*s*. 3*d*. [203

Other Countries

Tsetse Research Department, Tanganyika Territory. A Field Key to the Savanna Genera and Species of Trees, Shrubs and Climbing Plants of Tanganyika Territory. Part 1: Genera and some Species. By B. D. Burtt. Pp. xvi+53. (Dar es Salaam: Government Printer.) 2*s*. [123

Indian Population Problems. Report and Proceedings of the 2nd All-India Population and 1st Family Hygiene Conference. Edited for the Executive Committee by Prof. G. S. Ghurye. Pp. 336. (Bombay: Karnatak Publishing House.) 5 rupees. [123

Annual Report of the Imperial Council of Agricultural Research for 1938–39. Pp. viii+170. (Delhi: Manager of Publications.) 1.8 rupees; 2*s*. 3*d*. [123

Pasteur Institute of Southern India, Coonoor. The Annual Report of the Director for the Year ending 31st December 1938, together with the Thirty-second Annual Report of the Centre Committee of the Association for the Year ending 31st March 1939. Pp. 79. (Coonoor: Pasteur Institute of Southern India.) [123

Year-Book of the Royal Asiatic Society of Bengal. Vol. 5, 1939. Pp. 163. (Calcutta: Royal Asiatic Society of Bengal.) 4.2 rupees. [123

Maryland Geological Survey. Map of Maryland showing Geological Formations. Scale 1: 380,160 = 6 miles to 1 inch. 44in. × 26½in. 1 dollar. Map of Maryland showing Surface Elevations. Scale 1: 380,160 = 6 miles to 1 inch. 44in. × 26½in. 75 cents. Map of Carroll County showing the Geological Formations. Scale 1: 62,500 = 1 mile to 1 inch. 38in. × 36in. 50 cents. Geologic Map of Frederick County and adjacent parts of Washington and Carroll Counties. Scale 1: 62,500 = 1 mile to 1 inch. 53in. × 40in. 50 cents. (Baltimore, Md.: Maryland Geological Survey.) [133

Sveriges Geologiska Undersökning. Ser. Aa, No. 178: Beskrivning till kartbladet Gävle. Av R. Sandegren, B. Asklund och A. H. Westergård. Pp. 144+1 plate. (Stockholm: P. A. Norstedt and Söner.) 4.00 kr. [143

Gold Coast Colony. Annual Report on the Forestry Department for the Year 1938–39. Pp. iii+21. (Accra: Government Printing Office; London: Crown Agents for the Colonies.) 2*s*. [143

Ingeniørvidenskabelige Skrifter. Nr. 4: The Acoustic Air-Jet Generator. By Jul. Hartmann, in co-operation with Peter v. Mathes, Elisabeth v. Mathes and Freimut Lazarus. (Akademie for de Tekniske Videnskaber og Dansk Ingeniørforening.) Pp. 266+14 plates. (København: G. E. C. Gad.) [143

Indian Forest Records (New Series.) Utilization, Vol. 1, No. 8: Notes on the Air Seasoning Characteristics of some Indian Woods (Supplement to the Manual on the Air Seasoning of Indian Timbers.) Dr. S. N. Kapur and M. A. Rehman. Pp. iii+211–232. (Delhi: Manager of Publications.) 8 annas; 9*d*. [153

Annual Return of Statistics relating to Forest Administration in British India for the Year 1937–38. Pp. 40. (Delhi: Manager of Publications.) 2.4 rupees; 3*s*. 9*d*. [153

Supplement to the American Ephemeris, 1940. Total Eclipse of the Sun, October 1, 1940. (Issued by the Nautical Almanac Office, U.S. Naval Observatory, under the authority of the Secretary of the Navy.) Pp. 57. (Washington, D.C.: Government Printing Office.) 1·50 dollars. [193

Fifty-sixth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1938–39. Pp. 10. (Washington, D.C.: Government Printing Office.) [193

U.S. Department of Agriculture. Technical Bulletin No. 692: Chemical and Mechanical Methods of Ribes Eradication in the White Pine Areas of the Western States. By H. R. Offord, G. R. Van Atta and A. E. Swanson. Pp. 50+11 plates. (Washington, D.C.: Government Printing Office.) 15 cents. [193

National Research Council. American Geophysical Union Transactions of 1939. Part 1: Reports and Papers, Regional Meetings (a) South Pacific Area, Los Angeles, California, December 16–17, 1938; (b) North Continental Divide Area, Spokane, Washington, December 28, 1938. Pp. 140. 1.25 dollars. Part 2: Twentieth Annual Meeting, April 26 to 29, 1939, Washington, D.C.; Symposium on Floods, Section of Hydrology. Pp. 141–234. 1 dollar. Part 3: Twentieth Annual Meeting, April 26 to 29, 1939, Washington, D.C.; Reports and Papers, General Assembly and Sections of Geodesy, Seismology, Meteorology, Terrestrial Magnetism and Electricity, Oceanography and Volcanology. Pp. 235–484. 1.75 dollars. Part 4: Twentieth Annual Meeting, April 26 to 29, 1939, Washington, D.C.; Reports and Papers, Section of Hydrology. Pp. 485–740. 1.75 dollars. (Washington, D.C.: National Academy of Sciences.) 5 parts, 5 dollars. [193

OFFICIAL ANNOUNCEMENTS

BEIT MEMORIAL FELLOWSHIPS FOR MEDICAL RESEARCH

NOTICE is hereby given that an ELECTION of JUNIOR FELLOWS to begin work on October 1 will take place in July 1940. Junior Fellowships are normally of the annual value of £400 for three years; but candidates, younger than those usually elected or whose promise for medical research must be judged mainly on work outside that field, may be awarded a lower rate of £300 for the first two years. Candidates are asked to state whether they would be unable to accept this lower initial rate.

Candidates must have taken a Degree in a Faculty of a University in the British Empire or a Medical Diploma registrable in the United Kingdom. Elections to Junior Fellowships are rarely made above the age of thirty-five years.

The Trustees are desirous of furthering research in Mental Diseases and in the general allotment of Fellowships will give some preference to a candidate proposing research on approved lines in that subject.

Applications from candidates should be received by May 14, though late entries will be accepted up to June 1.

Owing to the disturbances caused by the War, it is necessary for candidates to submit evidence that they could be given accommodation in the departments where they propose to work.

Forms of application and all information may be obtained by letter only addressed to:

PROFESSOR T. R. ELLIOTT, M.D., F.R.S., Hon Secretary, Beit Memorial Fellowships for Medical Research, University College Hospital Medical School, University Street, LONDON, W.C.1.

SALTERS' INSTITUTE OF INDUSTRIAL CHEMISTRY

GRANTS-IN-AID

The Committee will in July allocate a limited number of Grants-in-Aid to young men and women employed in chemical works in or near London, who desire to extend their education for a career in chemical industry. Applicants must not be under 17 years of age. Applications should be made as soon as possible, and in any case not later than May 1, whereupon forms will be issued requiring particulars of age, nature of employment and the manner in which the Grant would be used. Address: The Director, Salters' Institute of Industrial Chemistry, Salters' Gardens, Church Road, Watford, Herts.

SALTERS' INSTITUTE OF INDUSTRIAL CHEMISTRY

FELLOWSHIPS

Applications are invited for Salters' Fellowships available for chemists of postgraduate standing. The object of the Fellowships is to afford special training by means of a course of Chemical Engineering at an approved College for one year. The course to be followed will, in each case, be decided in consultation with the Fellow. The value of a Fellowship is normally from £250 to £300.

Applications should be received by the Director, Salters' Institute of Industrial Chemistry, Salters' Gardens, Church Road, Watford, Herts, on or before May 1, 1940.

Full particulars and forms of application may be had on request.

HERIOT-WATT COLLEGE, EDINBURGH

PROFESSORSHIP OF CHEMISTRY

The Governors invite applications from British Subjects for the PROFESSORSHIP of CHEMISTRY, which will shortly become vacant owing to the retirement of Professor T. Slater Price, O.B.E., D.Sc., F.I.C., F.R.S. The Professor is Head of the Chemistry Department, which includes Day and Evening courses of study. The person appointed will be required to take up his duties on September 1, 1940. Teaching experience and works experience in some branch of Industrial Chemistry or Pharmacy is desirable. Salary £1,000 by £50 to £1,200. Particulars may be obtained from the Principal at the College, to whom applications should be sent by April 16.

J. CAMERON SMAIL,
Principal.

LEICESTER MUSEUM AND ART GALLERY

An ORGANIZER FOR SCHOOLS SERVICE (female) is required for the Leicester Museum. University degree essential; also Museum experience or knowledge of Museum and Art Gallery subjects. The work calls for skill of a specialized nature in the preparation and explanation of art objects, scientific specimens and other material for circulation. Salary £300 per annum.

Applications must be received not later than April 20, and must be made on forms obtainable from the undersigned.

E. E. LOWE,
Director.

Museum and Art Gallery,
Leicester.

CITY OF COVENTRY—WATER DEPARTMENT

APPOINTMENT OF WORKS CHEMIST

Applications are invited from suitably qualified persons, not exceeding 40 years of age, for the post of Works Chemist at the proposed River Avon waterworks, at a salary of £260 per annum, rising, subject to satisfactory service, by annual increments of £10, to a maximum of £300 per annum.

The new treatment works will consist of sedimentation tanks, pressure filters and chlorine and ammonia plant, and the chemist appointed must be capable of making all necessary routine analyses of the raw and treated waters and of directing the operation of the treatment plant. Previous experience in this work will affect appointment. He will also be required to survey and report on the drainage area above the new intake and to undertake general chemical work in the Department.

The post is designated under the Local Government and Other Officers' Superannuation Act, 1922, as amended in regard to annuities to widows by the Coventry Corporation Act, 1936.

The person appointed will be required to pass a medical examination, to contribute on the approved scale to the Staff Widows' and Orphans' Pension Fund, and to devote the whole of his time to the duties of the appointment.

Applications, endorsed "Works Chemist," stating age, qualifications, present occupation and experience, and accompanied by copies of not more than three recent testimonials, must reach the undersigned not later than Wednesday, April 24, 1940.

Canvassing, either directly or indirectly, will be a disqualification.

NORMAN J. PUGH,
Assoc.M.Inst.C.E., M.Inst.W.E.,
Water Engineer and Manager.

Water Department,
Council House,
COVENTRY.
March 21, 1940.

GOVERNMENT OF BENGAL

Applications are invited for an appointment as Assistant Livestock Expert for Animal Husbandry work in Bengal.

Candidates must be natural-born British subjects, or subjects of an Indian State, and should be not less than 25 nor more than 35 years of age. They must possess a degree or diploma in Agriculture, or the qualification of M.R.C.V.S., and not less than three years' postgraduate training in Animal Husbandry, including dairying and knowledge of small stock and poultry. They must have had adequate practical experience in Animal Husbandry, including the breeding of stock and dairying.

Terms for candidates of Non-Asiatic domicile:

Appointment for five years in first instance. Pay scale Rs.550 a month, rising by biennial increments of Rs.100 a month to Rs.1,550 a month. Initial pay according to age, subject to maximum of Rs.750 a month at age 30 and upwards. (Rupee=1s. 6d. approx.) Provident Fund. Free passage to India and return passage on satisfactory completion of agreement.

Note.—Special terms, which will be supplied on application, will apply to an appointee of Asiatic domicile.

Further particulars and forms of application may be obtained, on application by post card (quoting Appointment 9/2 A), from the High Commissioner for India, General Department, India House, Aldwych, London, W.C.2. Last date for receipt of applications April 27, 1940.

MINISTRY OF SUPPLY

STAFF FOR SCIENTIFIC RESEARCH

Experimental Assistants (Female) are immediately required at the Ministry's headquarters in London and at establishments in Woolwich, Bournemouth and Kent.

Applicants must have had training to degree standard in chemistry or physics or should have passed the Inter. B.Sc. or equivalent examination in these subjects, and should have one or more of the following qualifications:

(*a*) Good knowledge of languages (German essential).
(*b*) Experience in abstracting and indexing technical literature.
(*c*) Secretarial training.
(*d*) Experience in a technical library.

Salaries at fixed rates within the range of £130—£238 or at £265, according to age, qualifications and experience.

Candidates must be of British birth and parentage.

Application forms, obtainable by postcard from the Secretary (S.E.3b), Ministry of Supply, Adelphi, W.C.2, to be lodged not later than April 16, 1940. Quote Appts. O24/S.E.3b.

PORTSMOUTH MUNICIPAL COLLEGE

Principal: L. B. Benny, M.A.

Applications are invited for the post of HEAD of the Department of ELECTRICAL ENGINEERING, owing to the retirement of Mr. G. D. Aspinell Parr, M.Sc., M.I.E.E.

Applicants should possess high academic qualifications and good teaching and industrial experience.

Full particulars and Form of Application may be obtained from the undersigned, to whom applications should be returned not later than April 20, 1940.

F. C. WAUDBY,
Registrar.

April 1, 1940.

CEYLON UNIVERSITY COLLEGE

Applications are invited for the post of PRINCIPAL of the above College, and will be considered along with those from candidates already in the Ceylon Government Service. Candidates must possess high academic qualifications and considerable experience of administration in a University or institution of university status.

2. The appointment will be for 5 years only. The salary offered is £1,500 per annum, rising by increments of £50 to £1,750. A salary higher than the initial salary might be offered in the case of a candidate who was considered to have exceptional qualifications and experience. Free passages outward and homeward will be provided.

3. Candidates should apply in writing to the Director of Recruitment (Colonial Service), Colonial Office, 29 Queen Anne's Gate, S.W.1, forwarding a brief statement of age, qualifications and experience. Applications must reach the Director of Recruitment before April 30.

UNIVERSITY OF GLASGOW

LECTURESHIP IN PHYSICS

Applications are invited for the post of Lecturer (Grade IIb) in the Department of Applied Physics as from October 1, 1940. Salary scale £400—£480. Further particulars may be obtained from the undersigned, with whom applications (five copies), together with copies of not more than two recent testimonials and the names of referees, should be lodged not later than April 30, 1940.

ROBT. BROUGH,
Acting Secretary of University Court.

UNIVERSITY OF GLASGOW

LECTURESHIP IN ZOOLOGY

Applications are invited for the post of Lecturer (Grade III) in the Department of Zoology as from October 1, 1940. Salary scale £320—£380. Further particulars may be obtained from the undersigned, with whom applications (five copies), together with copies of not more than two recent testimonials and the names of referees, should be lodged not later than April 30, 1940.

ROBT. BROUGH,
Acting Secretary of University Court.

THE UNIVERSITY OF MANCHESTER

Applications are invited for the post of Assistant Lecturer in Geography. Candidates must have special qualifications in Physical Geography. Stipend: £300 per annum. Duties to commence September 29, 1940. Applications must be sent, not later than May 1, to The Registrar, The University, Manchester, 13, from whom further particulars may be obtained.

NORMAN SMITH,
Registrar.

UNIVERSITY COLLEGE, LEICESTER

Applications are invited for the post of Temporary Lecturer in Charge of the Department of Physics for the duration of the War. Salary £500 per annum. Duties to commence as soon as possible. Applications must be sent not later than April 17 to the Registrar, from whom further particulars may be obtained.

Research Engineer for Radio and Cathode Ray work

required. Practical experience absolutely essential, while mathematical ability will be an advantage. Applicants should give fullest details of training, experience, age, etc., to Box 702, T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4.

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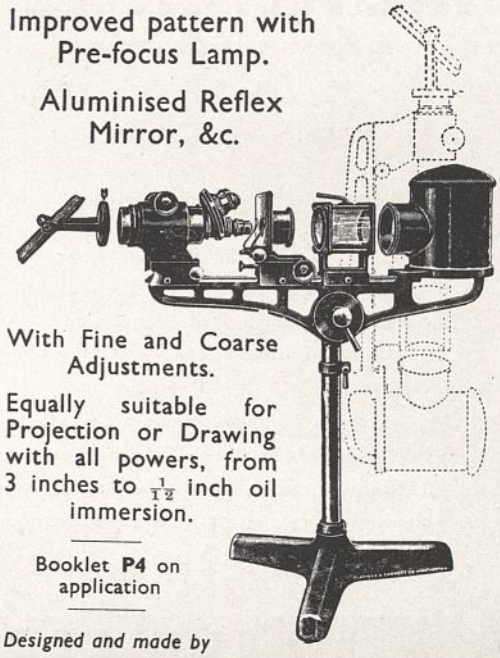

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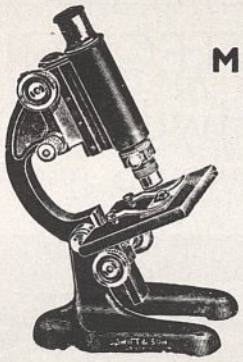

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