NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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NATURE

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TRAINING FOR THE COLONIAL SERVICES

THE Colonial Service is called upon to-day to deal with a whole range of problems that had not been contemplated when a course of training for entrants was first devised in 1924. The administrative officer, once concerned mainly with the maintenance of law and order, is now expected to be the active promoter of all those types of activity that have come to be grouped under the heading 'Development and Welfare'. A new type of training is called for, more appropriate to these new functions.

British faith in the amateur dies hard; in the Indian, Home and Sudan Civil Services, a university degree, in no matter what subject, is regarded as both a necessary and a sufficient qualification. In the case of the Colonial Administrative Service, this has been supplemented since 1924 by a course at Oxford or Cambridge, lasting one university session, in subjects relevant to the work for which the students are preparing—law, surveying and field engineering, colonial history, colonial administration, geography, anthropology, tropical agriculture and forestry, tropical hygiene, and languages. Contrast the provision made by the other major colonial Powers—the École Nationale de la France d'Outre-Mer in Paris, the Université Coloniale at Antwerp, the five-year colonial courses given at the Universities of Leyden and Utrecht. A recent addition to this list is the Australian School of Pacific Administration, which was opened in May of this year and is to be incorporated in the Australian National University. Australia's present plans are for a training period shorter than a normal university course—three months before, and two years after, the first tour of service. In all the other cases, the syllabus for a university degree is built around the special interests of the man preparing for work in the colonial field.

Britain still sees virtues in a 'general'—some might almost say an irrelevant—education. So the administrators of the British Colonial Empire must still cover the enlarged field of studies now considered necessary within the limits of the time they can spare when they have completed an undergraduate course. This has now been somewhat extended; there is to be a preliminary course of four terms (with special study during the 'long vacation'), and an additional one of six months after the first tour of service. The proposals which have just appeared* are based on a memorandum by Sir Ralph Furse, director of recruitment to the Colonial Office, which was discussed by a committee representing the Universities of Oxford, Cambridge and London, with the Duke of Devonshire as chairman. The memorandum is published as an annex to the Committee's report. It is emphasized that the proposals are tentative and may be revised in the light of experience.

Under the new plan, entrants on selection will go first to Oxford or Cambridge, where they will spend two full terms and a shortened summer term (to the

* Colonial Office. Post-War Training for the Colonial Service. Report of a Committee appointed by the Secretary of State for the Colonies. (Colonial No. 198.) Pp. 15. (London: H.M. Stationery Office, 1946.) 9*d.* net.

end of May) studying British Empire and Colonial history and administration, law, agriculture, geography and anthropology. They will then be allotted to their respective Colonies. The month of June and the following October term will be spent in London, mainly in the study of languages; to this the report would allot a minimum of three hours daily. At the same time, however, they are to take courses in the geography, sociology and administration of one of three major regions, West Africa, East Africa, or Malaya and the Pacific. The report remarks that "recruits are willing to work very hard so long as they believe that they are being given the tools for their future job". Willing they may be, but the breathless succession of lectures which this programme must involve is just what most university teachers would deplore. One wonders what was the compelling argument against devising a course extending over two university sessions.

During the 'long vacation', the students are to be given practical experience of the working of local government administration and of the social services in both urban and rural areas; this will presumably involve dividing them into small groups to be attached to different local authorities. This is the most interesting innovation in the proposed new course, and the one that most clearly reflects the new conception of the functions of the administrative officer; he is to be largely engaged in co-ordinating the work of specialists in 'development and welfare' schemes, and in encouraging the colonial form of local government—a native authority or whatever it may be—to take responsibility for the social services, which it is the present policy of Britain to extend as rapidly as possible. Another new proposal is that the second course, to be taken after the first tour of duty, shall be attended by officers of all the technical services as well as by administrative officers. This, it is hoped, will help to break down the isolation of the political from the specialist officer, and of specialist officers from one another, which has characterized too many Colonies in the past. It has been realized in Government quarters, ever since the Nutrition Committee reported in 1939, that the first essential in approaching any of the major problems of Colonial backwardness—malnutrition, soil erosion, illiteracy, disease—is the concerted attack, and most Colonies have recognized this to the extent of bringing the heads of all departments together to draw up development plans. At lower levels, however, co-operation is not yet taken for granted, and a combined course of training will have a most valuable influence in this direction. Sir Ralph Furse points out that the lectures recently introduced on the work and problems of the agricultural and forest services have already had good results.

The probationers are also to fit into their 'long vacation' a course of lectures on tropical hygiene and sanitation, and "possibly some instruction in" a number of miscellaneous subjects, the value of which seems open to question, judging from their titles. "Field Engineering", a reject from the pre-war course, evidently found an advocate who could not bear to see it go. "Colonial Accounts" appears from the text of the report to mean office routine work. "Tropical Housekeeping and Cookery" was introduced, it seems, in response to "colonial opinion"; but is an organised course required in order to explain that food goes bad quickly in hot climates?

Certainly no one could accuse the Committee of overlooking any subject likely to be of value to the administrative cadet; the question is rather whether so many can be adequately treated in the time available.

Sir Ralph Furse makes some interesting suggestions about the cadet's first tour of service. The work allotted to him should be planned with the view of giving him useful experience on different types of station and in different aspects of administration. He might be attached for short periods to officers of some of the technical departments. He should spend part of the tour at Makerere or Achimota in order to make the acquaintance of the educated African; and at the same time, since both those institutions are near Government headquarters, could see something of the working of a colonial secretariat and departmental headquarters offices.

Confirmation of appointment is to come at the end of this first tour. The officer will then return to Britain for a second course of six months, to be taken in London, and to consist mainly in discussions rather than in formal teaching. The subjects listed for this course are British colonial aims, comparative colonial administration, social administration, and one of several aspects of economics relevant to colonial problems. It is significant that in the case of the first subject alone, no indication is given of what the title covers; it could be argued that, though the methods of Colonial Powers differ widely, their aims are fundamentally the same, and that the first subject can only be treated as part of the second. In addition, students at this course will make a special study of some problem of anthropology, history, law, economics, education, agriculture or language. It is hoped that they will keep up a permanent interest in the subject selected. Provision is to be made, on a much larger scale than heretofore, for sabbatical leave for officers anxious to pursue their study further.

The second course is to be preceded by attendance at a summer school of the type that was so successfully organised at Oxford before the War. This will be open also to officers on leave in Britain. In future, summer schools are to be held both in Oxford and Cambridge, with the co-operation of London in providing lecturers and discussion leaders.

Sir Ralph Furse suggests that selected officers from the services of the Dominion mandated territories should be invited to attend all these courses; the report mentions them only in connexion with the summer school. While New Guinea was under military administration, the Australian Defence Department attached some importance to arrangements for giving selected officers experience of other Colonies, and a plan was adopted whereby four each year would be seconded for six months, of which three would be spent in a British Crown Colony and three at the Colonial Office. Only two had left Australia

when civil government was restored, and the Minister for External Territories did not continue the scheme. It has since been suggested that officers from the British Crown Colonies might attend the Australian School of Pacific Administration.

The financial provision involved in the necessary expansion of the Colonial Service and the new plans for training are discussed in a further memorandum*. This emphasizes, first, the need to implement the declared policy of throwing open the administrative service to suitably qualified men from among the colonial peoples by greatly increasing the opportunities for them to become qualified. For this purpose, a sum of £1,000,000 has been allocated from the Colonial Development and Welfare Fund over the next ten years for scholarships to enable selected colonial candidates for the service to receive education up to the same standards as those from Great Britain or the Dominions. The scholarships will be open to officers in subordinate grades of the public services as well as to entrants from outside.

The Government is also to provide a very much larger proportion than in the past of the cost of training, both general and technical. Formerly this was borne mainly by the Colonial Governments, though Great Britain financed scholarship schemes in the case of agricultural, veterinary and forest officers. For the next ten years, £1,500,000 is to be allocated from the Colonial Development and Welfare Fund for this purpose.

Principles are laid down governing the vexed question of salary scales for officers recruited locally and overseas. These are to be determined according to the nature of the work and the relative responsibilities, and are to be fixed at rates applicable to locally recruited staff, regard being paid to ruling levels of income in those classes from which the public services are recruited. Expatriation pay is to be provided for overseas officers, at rates which will take into account, among other things, the remuneration offered in alternative careers at home. The justification in these terms of the discrepancy in the salaries of officers recruited locally and overseas is logically unassailable; the recognition that the Colonial Service has to compete with alternative careers, and must offer conditions which will attract good men, is more important now than ever before; yet it is doubtful whether feeling on this point in the Colonies will be appeased by the division of the overseas officer's emoluments into salary and expatriation allowance.

Assistance is to be available under the Colonial Development and Welfare Act in special cases where a Colony's resources are insufficient to meet the cost of appointing overseas officers whom it needs.

The question whether Great Britain should take over the whole cost of the Colonial Service is discussed in a final paragraph. To do so would dispose of the argument that the Colonies should not be 'burdened' with the cost of a staff adequate in numbers and quality. This possibility is dismissed, however, on the ground that it would be politically retrograde to staff the higher grades of the Service with officers whose conditions of employment would not be controlled by the Colonial legislatures. The arrangement outlined in the paper is preferred because it "provides for a generous measure of assistance, so planned as to ensure that the Colonies will get a fully equipped Service in which the Colonial peoples themselves will take a progressively increasing share, while retaining the framework of existing institutions and safeguarding the principle of local self-government".

Although these reports contain many points which may be criticized, they are evidence of official recognition of the fact that the Colonial Services have many new problems to meet, for which the old training methods will be inadequate. The proposals are stated to be provisional, and their effects will be carefully examined.

* Colonial Office. Organisation of the Colonial Service. (Colonial No. 197.) Pp. 12. (London: H.M. Stationery Office, 1946.) 2*d.* net.

TRIASSIC FISHES FROM EAST GREENLAND

Studies on Triassic Fishes, I. (Palæozoologica Groenlandica)

By Eigil Nielsen. Pp. 394 + 30 plates. Meddelelser om Grønland, 138.) (København: C. A. Reitzels Forlag, 1942.) 22 kr.

WITH the exception of introductory pages and summaries, this work is identical with *Palæozoologica Groenlandica*, Bd. 1; parallel publication of fossil material will continue in this new journal and in *Medd. om Grønland*.

This volume, excellently printed in English on good paper during the German occupation of Denmark, is a most worthy member of the great series of monographs on fossil vertebrates produced under the direct influence of Prof. E. A. Stensiö of Stockholm. It shows the latest developments of techniques of freeing fossils from matrix, of serial sectioning, and of illustration, which have been worked out in Stensiö's laboratories. As in other large works of this school, the generous scale of publication allows extensive review of a whole group of fishes, and discussion of many problems; the excellent co-operation between the specialist palæontologists and the official expeditions is as marked as ever. Dr. Nielsen has himself spent several seasons, and wintered, in East Greenland, and collected much of the material now described. Vertebrate palæontology owes much to Dr. Lauge Koch's repeated, and outstandingly productive, expeditions to East Greenland.

Two genera of Eotriassic Actinopterygii are dealt with—*Glaucolepis* Stensiö (= *Pteronisculus* White) with five species, and *Boreosomus* Stensiö (= *Diaphorognathus* Brough) with one; their stratigraphical position is well defined. Both genera were first described from Spitsbergen, and have been definitely recognized elsewhere only from Eotriassic rocks in East Greenland and Madagascar—an intriguing problem of distribution.

About two hundred specimens of *Glaucolepis*, in calcareous concretions, permit the most comprehensive and detailed description of a 'palæoniscoid' fish ever published. The head has been investigated by exquisite positive preparation (the specimen illustrated on pls. 13–17, showing the whole branchial arch

skeleton, will delight all connoisseurs of the elegant in fossils) and by serial sectioning, helped by the use of alizarin to differentiate bone from matrix. The adult bony neural endocranium, which consists of two unpaired bones, develops from a number of paired and unpaired ossifications; this observation may help to explain conditions in higher Actinopterygii. The cranium is exhaustively discussed; the brain and cranial nerves and vessels can be very fully reconstructed. The membrane bones of the basis cranii and palate, and the whole visceral skeleton, are so well preserved that much earlier work is shown to be erroneous, and new problems are posed. The dermal bones of the outer surfaces of the head are known in great detail; their mutual overlap and their relations to the latero-sensory canals and pit-line grooves are fully discussed. Several interesting problems of terminology are raised. A separate quadrato-jugal is present (but not in *Boreosomus*, where Nielsen allows the possibility of its complete reduction). Elsewhere the compound terminology characteristic of the Swedish school is in evidence: for example, supratemporo-intertemporal, supraorbito-dermosphenotic, supraorbito-postorbital and lacrimomaxillary. While these names may give a good idea of topographical extent, they imply a fusion of bone rudiments; in many cases other explanations are possible, and even likely. The axial skeleton is fully described, and shows the expected agreement with *Acipenser*. The endoskeletal shoulder-girdle is very completely known; the pectoral fin must have been a nearly horizontal keel. In the pelvic skeleton, a short metapterygial axis may be present. *Glaucolepis* is undoubtedly a close relative of *Palæoniscus*, and is referred to the family Palæoniscidæ (s.s.).

Boreosomus differs in several respects from *Glaucolepis*; the endocranium is not so fully described, since serial sectioning was not completed. The pattern of the dermal bones, the body-shape, position of fins and scale-ornamentation indicate relationship to the 'palæoniscoid' family Acrolepidæ, to which Nielsen refers *Boreosomus*. But the reduced body-lobe does not quite reach the tip of the caudal fin; this is a feature characteristic of the grade 'Sub-Holostei', as defined by Brough, and *Boreosomus* forms an excellent bridge between the Acrolepidæ and the sub-holostean Ptycholepidæ. On balance, *Boreosomus* should probably be referred to the latter family. The base of the pectoral fin is almost vertically placed, and this change from what seems to be a generalized 'palæoniscoid' structure is a big step towards the higher Actinopterygii, possibly associated with the reduction of the body-lobe of the caudal fin, as I have suggested elsewhere.

This work emphasizes almost too pointedly a trend with grave implications for British palæontology. A number of highly skilled preparators, photographers and illustrators collaborated, as in all the other great works produced by Stensiö's school. In many American institutes similar facilities are commonly available. In most British laboratories and museums such technical staff is practically non-existent or hopelessly overworked, and a great mass of fossil treasure in our museums is in wait for full discovery. The same is true in other studies; there are departments without even the facilities for preparing thin sections of rocks and fossils. The training and wider employment of skilled technicians is one of the greatest needs of British science.

T. Stanley Westoll

INSTRUMENTS IN PRESENT-DAY SCIENCE

Major Instruments of Science and their Applications to Chemistry

Edited by R. E. Burk and Oliver Grummitt. (Frontiers in Chemistry, Vol. 4: Published under the auspices of Western Reserve University.) Pp. xii + 151. (New York: Interscience Publishers, Inc., 1945.) 3.50 dollars.

The Electron Microscope

Its Development, Present Performance and Future Possibilities. By Dr. D. Gabor. (Electronic Engineering Technical Monographs.) Pp. 104. (London: Hulton Press, Ltd., n.d.) 4*s*. 6*d*. net.

Scientific Instruments

Described by specialists under the Editorship of Herbert J. Cooper. Pp. 293. (London: Hutchinson's Scientific and Technical Publications, 1946.) 25*s*. net.

At a luncheon of the Physical Society in Cambridge shortly before his death, Sir J. J. Thomson commented whimsically on the equipment needed in a present-day physical research laboratory. When he became Cavendish professor in 1885, he said, his annual allowance for equipment was never more than a few hundred pounds, but "nowadays they want all of that for a new magnet". It is indeed a commonplace that a very great part of present-day research in physics, and increasingly also in chemistry, relies on the use of elaborate equipment which, even had it been available, would have been quite beyond the means of university laboratories a couple of generations ago, when glass and string and sealing-wax, and silk-covered wire and adequate primary batteries, gave contemporary genius much of the material help it needed in exploring the unknown.

Since those days scientific work has undergone great expansion in the schools and universities, and now it is well on the way to permeating industry. Science is being used, and with that use there has arisen a vigorous scientific instrument industry providing measuring devices of increasing power and precision to a growing body of users willing, and more often able, to pay for them. One result of this is that measurements which formerly would have taxed the resources of the best-equipped laboratories are now made as a matter of daily routine; but added to this we have seen the development, largely in industrial research laboratories, of new instruments and techniques which in their turn are already making important contributions to our knowledge of fundamentals. Nowhere, perhaps, is this to be seen more clearly than in the fields of electronics and optics, with which the books under review are mainly concerned.

"Major Instruments of Science and their Applications to Chemistry" is based on a series of lectures delivered by outstanding workers to mixed audiences at the Western Reserve University "as a mechanism for presenting to graduate students the flow of chemical research, and for keeping industrial chemists abreast of their science". Of the five contributors, it may be noted, three come from leading industrial concerns. Dr. L. H. Germer writes on electron diffraction, Prof. L. Marton on the electron microscope and its applications, Dr. M. L. Huggins on X-ray diffraction, Prof. W. R. Brode on chemical spectroscopy and on absorption spectra, and Dr. R. Bowling Barnes on the infra-red spectrometer and its application. In each case the author's approach is elementary,

but the subject is developed, as smoothly as space limitations permit, to a stage where the power of the instrument in question in investigating physical and chemical structures, whether for the purposes of research or identification, is clearly brought out. The result is a slim but eminently readable and stimulating volume which should succeed notably in its object.

A few examples will illustrate the extent to which the articles reflect the more valuable trends in present-day technique with these instruments. Brode, in dealing with chemical spectroscopy, summarizes the so-called internal-standard method, whereby a comparison of the densities or transmissions of groups of neighbouring spectral lines due to two elements, one of which may be regarded as the 'unknown', gives a direct measure of the unknown without recourse to a specific plate calibration, provided the excitation conditions of the source are sufficiently stable and the comparison lines are carefully chosen. Again, Barnes shows how the infra-red spectrum of a pure compound, being unique, 'fingerprints' the molecule and so permits its rapid identification; while Huggins gives examples of the fascinating photographic methods (for one of which he was himself responsible) which are now being used to build up trial models of crystals the X-ray diffraction spectra of which are known. The articles include bibliographies which will be found useful by readers approaching the subjects for the first time and which, in Marton's article for example, will be of value also to the expert.

Dr. Denis Gabor's little book is in rather a different category. It forms the third of a series of monographs published by the Hulton Press, and publishers and author alike are to be congratulated on having produced, at a very modest price, a most useful addition to the literature of a subject which, though it has reached a sturdy adolescence, lacks as yet an adequate literature in book form. Dr. Gabor's treatment is systematic, approaching the elements of geometrical electron optics by way of the Hamiltonian analogy between the path of a particle in a conservative field and that of a light-ray in a refracting medium. After describing the simpler aberrations to which electron lenses are subject, he discusses the origin of contrast in the electron microscope, showing in particular the part played by spherical aberration even when electrons are inelastically scattered by the object and 'chromatic' aberration is therefore absent. This naturally leads to a consideration of resolution and detection limits in the present-day instruments, which lie in the region of 10–20 A. The principal instruments are then described, together with the techniques of specimen-preparation and some of the more striking results. This straightforward account receives added value from a series of chapters, forming the final one-third of the book, devoted to possible future developments and to the ultimate limit of electron microscopy. Here the author has himself made noteworthy contributions and the book has in consequence the unexpected air of a research record rather than a review. The book is not dated and there are minor awkwardnesses of expression and misprints (notably, on p. 16, where 0·001 in. is said to equal 40,000A.), but these, it is hoped, will be rectified in future editions.

"Scientific Instruments" is intended for a much wider circle of readers than either of the foregoing works. Fifteen contributors have produced some thirty chapters, each dealing with a different type of instrument, and the editor has had the unenviable task of arranging the mass of material in such a way as to give a balanced picture which shall appeal at once to scientific workers out of their own special fields and to intelligent laymen. The result is not altogether happy, and the reader may feel with the reviewer that the very breadth of the objective is responsible for this, though much could have been done to improve the balance of the work. For example, it is doubtful whether a reader able to appreciate the clear but condensed account of mass spectrographs on pp. 90–94 would require to be given (on p. 154) wordy formulæ on the relation of the Fahrenheit to the Centigrade scale of temperature: nor would he be content with the determination of the upper fixed point of a thermometer by immersing it "in steam from boiling water". Other examples of the same sort could be given; examples, too, of duplication (as between the chapters on "Pressure" and on "Barometer, Barograph and Altimeter"). Electrical instruments, on the other hand, receive scant treatment, a chapter on moving-iron and moving-coil instruments being widely separated from a brief account of electronic devices, which is deposited next to calculating machines in a final section having the heading "Miscellaneous". Yet with it all the book is on the whole well produced and extremely well illustrated, and if used with care will serve as a handy work of reference. It is to be hoped, therefore, that it will have a sufficiently wide appeal to warrant later editions in which its defects of arrangement and presentation may be remedied and the whole properly indexed.

L. V. Chilton

FLOUR MILLING

Flour Milling

By J. F. Lockwood (assisted by Anthony Simon). Pp. 511. (Liverpool, London and New York: Northern Publishing Co. Ltd., 1945.) 25*s*. net.

PERHAPS nobody is better qualified than Mr. Lockwood to write an up-to-date treatise on flour milling. Apart from his own qualifications and experience, he is a director of the firm of Henry Simon, Ltd. and thus able to draw upon the wealth of technical knowledge available within that large organisation.

Flour milling is first and foremost a craft. The university may turn out an engineer in three years and a physician and surgeon in five, but the milling student requires a very much longer apprenticeship before he can graduate as a miller. Fortunately, the scientific worker in an industry need not be, and rarely is, one of its craftsmen, and for such outsiders, Mr. Lockwood has written an introduction entitled "A Simple Outline of Flour Milling" which is a masterpiece of condensation and invaluable to the research worker who wishes to acquaint himself with the broad principles of the flour milling process.

The introduction of the man of science into any industry sooner or later upsets any tranquillity it enjoys, and flour milling is no exception. Good colour and baking quality are no longer the only prerequisites, and the miller is now equally concerned about the vitamin B_1, calcium, fibre contents, etc., of his flour. Milling is rapidly becoming a highly selective process with as much emphasis on what should be included in the finished flour as excluded. For its type, the book contains a good account of recent developments in the nutritional field together with the preliminary engineering steps that have to

be taken to keep pace with them. Flour milling certainly promises to be an outstanding biological-engineering process, and when it is realized how much of this biological work has been carried out in the last decade it may well be that before long flour milling as we know it to-day will be radically altered. In any event, the 1960 edition of Mr. Lockwood's book should call for much revision.

The book is well produced and the figures and diagrams are of a high standard. It occupies some five hundred pages including thirty-eight well-balanced chapters; historical detail, more the concern of specialized works, is quite rightly omitted. There is an excellent survey of wheat characteristics and testing, including a scientific analysis of the subjects of wheat cleaning and screen-room separators, particularly in regard to the use of air currents. The conditioning of wheat is discussed in detail, and this chapter includes a useful account of the heat relations of various commercial dryers and conditioners. A series of chapters describes the principles of grinding and sifting and the main divisions of milling—breaking, grading and dusting, purification and the scratch and reduction systems; each is lucid and authoritative. The last five chapters deal with the mill management and costs. Finally, there are a number of appendixes, which will interest the mathematical physicist, as well as a glossary of milling terms in different languages.

This first-class and most stimulating book should be the *vade mecum* of every miller, milling technologist and the cereal chemist who wants to know and understand the practical implications of his work.

T. Moran

FROST DAMAGE TO FRUIT TREES

Frost and the Fruitgrower

By Raymond Bush. Second edition. Pp. viii + 119 + 23 plates. (London, Toronto, Melbourne and Sydney: Cassell and Co. Ltd., 1946.) 10*s*. 6*d*. net.

THE British fruit crop of 1945 was very seriously curtailed by severe frost damage, and many parts of the country have experienced similar trouble in the present season. Mr. Bush shows in this volume that the fruit yield of England and Wales varies from the average by nearly 300 per cent, as against 30 per cent in the United States, 37·5 per cent in Canada, and 17 per cent in Australia. The causes of this large variation are not fully understood, but damage by frost must be important. These facts assault the whole structure of home fruit production, and in a generation much less content to accept 'acts of God' than formerly, it is natural to inquire what can be done to mitigate the trouble.

Mr. Bush's book supplies at least a partial answer to these problems. He reviews many aspects of the problem, chiefly those relating to radiation frosts. It is now well established that damage from such frosts can be minimized by the avoidance of 'frost holes' for the establishment of orchards, the use of certain planting methods, and the modification or elimination of barriers to air drainage. 'Frost holes' are low-lying areas which receive and retain cold air collected from a wide region. The most suitable frost-free sites are gentle slopes with good drainage of cold air from below the orchard. Wind-breaks, hedges, and the fruit trees themselves all impede this downward flow of cold air. Hedges can be replaced with netting; wind-breaks can be cleared at the base, while trees should be planted at about the rate of one hundred per acre. Standards should be planted at the base of a slope, with bush trees at the top. All this is portrayed with a clarity of text, simple diagram and photograph which should appeal to the practical grower.

The author has performed a great and timely service to British fruit growers. He has interpreted adequately all the knowledge of frost damage control which can at present be applied in practice. Frost damage in the Clyde Valley in 1945 and 1946 does not, however, fit completely into the picture he has painted. There is the additional factor of wind, acting apart from katabatic flow. Research has, however, now been directed to this and other outstanding matters of frost damage and control. The author is only at the mercy of time as the fourth dimension in this respect. The enlightened practice of his present conclusions would go far towards a solution of the problem of frost damage.

The volume also deals with phenology in relation to frost damage, thus involving varietal effects. It figures various types of frost damage to blossom and to mature fruit. Methods of forecasting frost are considered, and would form the basis for future trial. Orchard heating is discussed, not as a finite method of control, but as a useful possibility in certain topographical situations. The book is an intelligent evaluation of present knowledge upon the subject, and research workers have already accepted the challenge to fill the gaps revealed by Mr. Bush's text.

John Grainger

SOME COLEOPTERA OF FRANCE

Faune de France

44: Coléoptères Bruchides et Anthribides. Par Adolphe Hoffmann. (Fédération française des Sociétés de Sciences naturelles: Office central de faunistique.) Pp. 184. (Paris: Paul Lechevalier et fils, 1945.) 250 francs.

WE welcome the appearance of another instalment of the Faune de France series of monographs. The present contribution deals with five small groups of Coleoptera which the author regards as constituting separate families. The most important of these are the Bruchidæ, which comprise seven genera and sixty-eight species within the faunal limits of France. The Anthribidæ are represented by six genera and twenty-one species. The genus *Urodon*, which has long been attached to this family, is placed by M. Hoffmann in a separate one of its own—the Urodonidæ, transitional between the Rhynchophora and Phytophaga. Some modern authorities, it may be added, relegate it to the Bruchidæ. Five species of the genus are included in the French fauna. The Brenthidæ also come in for consideration. They comprise but a single French species *Amorphocephalus coronatus*, which lives in association with ants of the genus *Camponotus*. Finally, a separate family—the Nemonychidæ—is erected to replace the tribe Rhinomacerini of the Curculionidæ. It is considered transitional in structure between the last-named and the Scolytidæ. Three genera, each with a single species, are included within the faunal limits. The work, as a whole, is well up to the standard of its predecessors; it is adequately illustrated, the figures of the species of Anthribidæ being particularly effective, and there is the usual compendium of diagnostic keys to the genera and species dealt with.

A. D. Imms

Collected Papers on Metallurgical Analysis by the Spectrograph

Edited by D. M. Smith. Pp. xi + 162. (London: British Non-Ferrous Metals Research Association, 1945.) 21*s*.

THIS volume comprises a representative selection made by Mr. D. M. Smith of papers submitted to the spectrographic panels set up by the British Non-ferrous Metals Research Association. The result of this selection is a volume from which spectrographers may derive helpful guidance in the correct choice of analytical methods for the routine examination of aluminium, lead, zinc, copper and platinum and their alloys. Photographic plate calibration and processing have also not been overlooked.

Special mention should be made of the contribution from the laboratories of the British Aluminium Company, Ltd., on the analysis of aluminium and its alloys. This paper is much more comprehensive than most of the others which are included in the volume, and the results are likely to be as valuable to spectrographers dealing with the analysis of aluminium alloys as the work of Barker and his collaborators has been to those dealing with the analysis of steels.

The reviewer has noted that nearly all of the work reported has been carried out with conventional D.C. arc and condensed spark circuits. This emphasizes the fact that while much attention has been given to variations due to metallurgical sampling and to photographic techniques, by no means so much attention has been given, in spectrographic work in Great Britain, to the other major source of inaccuracy, namely, the spectrographic source. The investigation of source characteristics forms one of the terms of reference of the General Research Panel of the B.N.F.M.R.A., and the reviewer feels that the value of the present volume would have been considerably enhanced had it been possible to include reports on work within the scope of this Panel, which has no significant representation in the book. A. H. S.

Qualitative Inorganic Microanalysis

A Short Elementary Course. By Ronald Belcher and Dr. Cecil L. Wilson. Pp. viii + 68. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1946.) 2*s*. 6*d*.

THE authors of this small text-book believe that the adoption of micro-methods of qualitative analysis would be furthered if the subject could be presented in a simple way which would enable junior students to take up the method with a minimum of special apparatus and with a possibility of success. Most of the apparatus required, apart from a centrifuge, can be made by the student, suitable directions being given. Modern tests and separations are described, and the instructions are clear and adequate, no theory being introduced. The course can be regarded either as supplementary to a normal course of qualitative analysis, or as providing first instruction in the latter, when it may be reckoned to occupy a twelve weeks course of three hours a week. The apparatus is illustrated by clear and effective diagrams, and schemes for routine analysis are given.

All teachers interested in micro-analysis, whether in school or more advanced laboratories, will find this a useful and interesting book, and the subject is one which young students will probably find attractive. One of the troubles of the teacher of qualitative analysis is the tendency to dirty and untidy work in the laboratory, and it is certain that the use of micro-methods would put an end to this. The training would be valuable, and altogether the authors seem to have made out a good case for the use of such methods as standard practice. The book is well printed and bound in limp covers, and the price is very reasonable.

The Adventure of Youth

The Psychology of Adolescence and its Bearing on the Extension and Reform of Adolescent Education. By Dr. Olive A. Wheeler. Pp. ix + 212. (Bickley: University of London Press, Ltd., 1945.) 6*s*. net.

IN planning extensions and reforms of adolescent education, most local education authorities have become fully aware that they can only be prepared by exact knowledge and sympathetic understanding of the needs of youth. In this book, which is an extension of and natural successor to her earlier work on this subject, Prof. Wheeler surveys the characteristic developments of, and variations among, adolescents. A careful survey is made of existing provisions for adolescent education and the service of youth in Britain, and the extensions and reforms which are now projected are treated to a critical examination based on facts built up during the author's long experience in this field. Internal problems like those of the curriculum, educational and vocational guidance, methods of discipline and teaching, and the religious and moral education of adolescents are also subjected to close scrutiny, and means of solving them are suggested. Like its predecessor, this valuable book supports the view that Prof. Wheeler is one of our foremost authorities on the education of the adolescent. T. H. HAWKINS

Friends in Fur and Feather

By Frances Pitt. Pp. 208+49 plates. (London: *Country Life*, Ltd.) 12*s*. 6*d*. net.

A NEW book on animals by Frances Pitt needs little more by way of comment than bringing it to the attention of all who have read her earlier stories of animals. This one, the story of all her many pets over many years, is worthy to take its place with any she has written because it offers so much to the animal-lover and not a little to the student of animal behaviour. At this stage of the peace it may be a little ungracious to complain of the production itself. Yet Frances Pitt has written such a delightful book, which will long find a place on many shelves, that it seems a pity better paper could not have been found for the text. The photographs, taken by the author, are, on the other hand, well produced.

The British Journal Photographic Almanac and Photographer's Daily Companion, 1946

Edited by Arthur J. Dalladay. Pp. 412 + 31 plates. (London: Henry Greenwood and Co. Ltd., 1946.) 3*s*. 6*d*. net (paper), 5*s*. net (cloth).

THE latest edition of this well-known almanac carries all the features which have made it so useful in the past—features such as tables and formulæ, legal and commercial information and very full advertisements of current materials and apparatus—but continued paper shortage has limited a number of sections. J. Allan Cash, whose work for the British Council is well known, writes on "Industrial Photography with Miniature Cameras", while other contributed articles of interest to readers of *Nature* are "The Photography of Lepidoptera", by Edward Richardson, and "Films for Children in Education and Entertainment", by Mary Field.

THE ROYAL GREENWICH OBSERVATORY

By Sir HAROLD SPENCER JONES, F.R.S.
Astronomer Royal

WHEN Charles II decided in 1675 to found an observatory for "rectifying the tables of the motions of the heavens, and the places of the fixed stars, so as to find out the so-much desired longitude of places for the perfecting the art of navigation", he provided a site in the Royal Park at Greenwich, "upon the highest ground, at or near the place where the Castle stood". Sir Christopher Wren was appointed architect of the observatory, and the pleasing building which he designed "for the observator's habitation and a little for pompe", as he wrote in one of his letters, still stands, a symbol of the continuity between the observatory of to-day and the observatory of 1675.

Greenwich was a pleasant village in open country, several miles from London, when it was selected as the site for the Royal Observatory. But London has gradually grown outwards until it has entirely surrounded the Observatory, and the conditions for astronomical observations at Greenwich have become progressively more and more unfavourable. The first serious menace to the work of the Observatory came in 1905, when the London County Council erected a power station for its tramway system on the Greenwich meridian, immediately to the north of the Observatory, and adjacent to the noble buildings of Greenwich Hospital, occupied by the Royal Naval College. Such callous disregard of local amenities by a public authority would be less likely to happen nowadays, when the public conscience is fortunately more alive to the need for the preservation of amenities, which are of concern to the nation as a whole.

The impurity of the atmosphere at Greenwich and the increasing brightness of the sky at night, caused by brighter street lighting, have been so detrimental to the observational work that the removal of the Observatory from Greenwich had to be faced, if the Observatory were to be able to continue to make contributions of value to observational astronomy. Thus, for example, the non-uniform and variable transparency of the sky has made any type of photometric work impossible, while the brightness of the sky has put the installation of modern equipment, with great light grasp, out of the question. The matter was brought by the Astronomer Royal to the attention of the Board of Visitors of the Royal Observatory in 1938. Since then, extensive search for a new home for the Observatory, where conditions are favourable for observation, has been made. It was recently announced by the Admiralty that Herstmonceux Castle in Sussex had been selected, in consultation with the Board of Visitors, as the most suitable of a number of possibilities. Along with the Castle, some 370 acres of ground are being acquired for the erection of the instrumental equipment and as a safeguard against the encroachment too near the Observatory of any buildings which might prove detrimental to the work.

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HERSTMONCEUX CASTLE: SOUTH AND EAST FRONTS

Herstmonceux Castle was built by Sir Roger de Fienes, treasurer to the Household of Henry VI, who in 1441 obtained a licence to "enclose, crenellate, and furnish with towers and battlements his manor of Herst Monceux". The Castle was built in brick of a mellow red colour, the bricks being almost certainly of local origin. Brick was still at that time largely an alien material; there are no important brick buildings south of the Thames earlier than Herstmonceux, which is probably not only the finest

early brick building in England but also the most beautiful of English baronial buildings. The mouldings and dressed work are for the most part executed in stone, a greensand, which gives great sharpness of detail and which has weathered well.

After 1740 the Castle fell into neglect, and in 1777 the interior, including the buildings in the court within the main rectangular structure, were demolished and the materials used to build the mansion now known as Herstmonceux Place. Little remained of the original fabric beyond the outer walls, with their towers, and portions of the inner walls. In 1911 the Castle was purchased by Colonel Claude Lowther, who commenced the restoration. After his death it was acquired in 1932 by Sir Paul Latham, Bart., under whose direction the restoration was completed by Mr. W. H. Godfrey. The outer walls and towers were carefully repaired and restored to their original condition; the ivy was removed from the walls; and the moat, on the east, south and part of the west fronts, was refilled with water. The reflexion of the Castle in the water of the moat, emphasizing the vertical lines of the towers, adds greatly to the beauty and impressiveness of the Castle.

The situation of the Castle was thus described by Francis Grose ("Antiquities of England and Wales", 5, 157–8), a century and a half ago:

"The Castle of Herstmonceux stands in a pleasant park, well diversified by hill and vale, finely wooded with old trees, and well watered by clear pools, and from it there is a fine view over the adjacent rich level of Pevensey (in the midst of which, on a little rise, is the town and ancient ruined Castle of Pevensey). The sea appears in front, southward of the hills towards Hastings to the east; and the South Downs rise mountain-like at some distance to the west. The Castle is seated near the southern edge of the park, and rather in the lowest part of it; the soil is, however, very dry."

In this noble and dignified castle, rich with historical associations, the Observatory will in the future find a home befitting its long traditions. In the grounds which have been acquired surrounding the Castle there is ample space for setting up the present instrumental equipment and future additions to it. The conditions for astronomical observation are about as good as can be found in England and, freed from the hampering conditions under which it has worked for many years, the Observatory will have new opportunities for making contributions of importance to the promotion of astronomical science.

Because of the long association of the Observatory with Greenwich and the selection in 1884, by international agreement, of the Greenwich meridian as the prime meridian of longitude, in recognition of the great contribution of the Observatory to astronomical and nautical science, the Royal Observatory will be known in its new site as the Royal Greenwich Observatory. The Observatory will no longer remain on the prime meridian, but there will be a sufficient overlap in observations at Greenwich and at Herstmonceux for the longitude of the new site to be determined with the necessary degree of accuracy.

The Nautical Almanac Office, which it has not been possible to accommodate with the observational departments of the Royal Observatory on the restricted site at Greenwich, will also be housed at Herstmonceux Castle. The closer association between the observational and computational branches of the Royal Observatory, which will thus become possible, will be to their mutual advantage.

A THEORY OF CHROMOSPHERIC FLARES

By R. G. GIOVANELLI

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IT has been established from observation that chromospheric flares are closely associated with sunspots, and that the probability of a flare occurring near a spot increases with the size of the latter. The probability is higher when the group is increasing its size than when it is stationary, and it is also higher for the magnetically complex $\beta\gamma$- and γ-groups than for the simpler α- and β-type groups[1]. The flares themselves are short-lived phenomena, of mean life about thirty minutes, and are quite localized. It is generally accepted that they show no velocity either in height or across the surface of the sun.

A mechanism is proposed here for the production of these flares based on the energies acquired by charged particles moving in induced electric fields associated with sunspots.

Strong magnetic fields exist in sunspots, and there is a large magnetic flux from the spots. It is usually agreed that the field due to a spot extends to an appreciable distance from it[2]. During the growth of a sunspot, there must be electric fields induced in its neighbourhood, and if the axis of the spot be vertical, the lines of electric force will be circles coaxial with the spot and parallel to the sun's surface. The magnitude of the electric field at a given point will depend not only on the rate of growth of the spot, but also on the conductivity of the surrounding medium. The existence of a magnetic field away from the spot, however, indicates that the conductivity does not prevent the magnetic field from being established in a time at least comparable with that required for the spot to grow. It is reasonable, therefore, to compute the magnetic and induced electric fields for a surrounding medium of zero conductivity and apply these results to determine the order of magnitude of the actual fields; provided that polarization charges do not become serious.

For a sunspot growing uniformly, in 50 hours, to a diameter of 7×10^8 cm., that is, one-hundredth of that of the sun, and a maximum magnetic field of 2,000 gauss, the magnetic and induced electric fields may be computed by treating the sunspot as a circular coil of the same radius carrying a current such as to produce, at any time, the same axial magnetic field. The electric and magnetic fields, which are mutually perpendicular, are given below for radial distances, in the plane of the coil, 2·5 and 5 times the spot radius, that is, in the region where flares frequently occur.

Distance from centre of sunspot (cm.)	Magnetic field (gauss)	Electric field (volt/cm.)
$3{\cdot}5 \times 10^8$	8	$1{\cdot}55 \times 10^{-3}$
$1{\cdot}75 \times 10^8$	64	$6{\cdot}2 \times 10^{-3}$

Chapman and Cowling have shown[3] that, in crossed electric and magnetic fields, charged particles undergo a drift which has a component velocity in the direction of the electric field amounting to

$$v = \frac{Ee\tau}{m(1 + \omega^2\tau^2)},$$

where τ is the mean time between collisions and ω is eH/m.

Considering the motion of electrons in these fields, they will on the average acquire energy between collisions, and if this be greater than the loss due to elastic collisions, which with hydrogen atoms is about one-thousandth of the electron energy, the average energy will increase until excitation of the atoms can occur. The increase of energy will be much less with protons, owing to their greater mass, and they are therefore afterwards neglected.

For an electron to acquire energy equal to the first ionization potential of hydrogen atoms it can be shown that

$$\frac{E^2\lambda^2}{1 + 8{\cdot}8 \times 10^{-3}H^2\lambda^2} \geq 2 \times 10^{15},$$

where λ is the mean free path and E is in E.M.U., so that if $H = 0$, then $\lambda \geq 4{\cdot}5 \times 10^7/E$. If E is 10^{-3} volt./cm., that is, 10^5 E.M.U./cm., then $\lambda \geq 450$ cm.

This discussion has neglected the distribution of velocities about the mean, so that, clearly, some excitation of hydrogen atoms will take place for shorter mean free paths than given above. When Cillié and Menzel's results for electron distribution in the chromosphere[4] are combined with Cowling's figures for cross-sections of protons[5], it is found that a mean free path of 450 cm. occurs about the middle of the chromosphere, some 6,000 km. above its base. If the induced field exceeds the above value, then the excitation occurs down to lower levels in the chromosphere.

If, in the equation above, $8{\cdot}8 \times 10^{-3}\ H^2\lambda^2$ is large compared with unity, then $H \leq E/1{\cdot}32 \times 10^6$ and for the same value of E as above $H \leq 7{\cdot}5 \times 10^{-2}$ gauss. Thus excitation can occur with mutually perpendicular electric and magnetic fields only if the magnetic field is very small, and it is of interest to see whether such conditions can exist in the chromosphere.

The presence of a general magnetic field on the sun was announced by Hale in 1913, its magnitude being given as about 25 gauss. While there is still some doubt expressed as to the actual existence of the field owing to its small size, recent measurements by Thiessen[6] confirms its reality.

Apart from a general magnetic field, fields from other sunspots may still be of appreciable size in the neighbourhood of the spot under consideration. It is thus to be expected that there will be places where actual neutral points exist and where conditions are thus suitable for the excitation of atoms by collision.

It is not essential that the magnetic field be small for electrons to acquire high energies : this is only the requirement so long as the electric and magnetic fields are assumed to be mutually perpendicular. If, owing to an external magnetic field, the electric field has an appreciable component in the direction of the resultant magnetic field, the electrons will have a component of their drift velocity in that direction, and this component will not be affected by the magnitude of the magnetic field.

In the above discussion, polarization charges have not been considered, and it remains to be shown whether they can influence the electric field to a significant extent. Cowling[5] has developed equations giving the conductivity of the material in the sun's atmosphere in the form

$$\sigma^{\mathrm{I}} + i\sigma^{\mathrm{II}} = \{6{\cdot}8 \times 10^{13}\bar{Z}T^{-3/2} - i\ 8{\cdot}6 \times 10^3 HT/\rho_e\}^{-1} \text{ E.M.U.},$$

where σ^{I} and σ^{II} are the direct and transverse conductivities for mutually perpendicular electric and magnetic fields. $\bar{Z}$ is the mean degree of ionization, T the (electron) temperature and ρ_e the electron pressure. Throughout the chromosphere the direct conductivity is of the order of 10^{-8} E.M.U. for very small magnetic fields, while for magnetic fields greater than 0·1 gauss both conductivities are very much less, becoming negligible in comparison with the conductivity for zero magnetic fields and, for non-perpendicular fields, with the conductivity along the lines of force. Thus in the chromosphere, except near neutral points, electrons are constrained to move in the direction of the magnetic field. However, in and below the reversing layer, conditions are such that magnetic fields of the order of hundreds of gauss will have little effect on the conductivity, owing to the much higher electron pressure.

If the external magnetic field be inclined to the surface, the neutral point will be either higher or lower than the spot, according to the direction of the external field and the polarity of the spot. If the neutral point be in the chromosphere, then electrons moving away from this point under the influence of the electric field will eventually reach a region where the magnetic field is strong enough to confine movement to the lines of force. These lead down to the reversing layer where the conductivity is high enough to prevent the accumulation of space charges.

Along lines of force which pass into the sunspot, the question of the magnitude of any space charges which may be built up in these regions depends at least in part on whether currents will flow transversely through a sunspot. It is not necessary, however, to indicate here whether or not this is the case, as any polarization fields built up in these regions will tend to increase rather than decrease the electric intensity in the neighbourhood of the neutral point, and thus cause no blockage to the mechanism. A similar result follows from any space charges due to the movement of electrons along the lines of force of the external magnetic field.

The above discussion has shown that it is possible to have localized regions in the chromosphere where electrons acquire sufficient energy to cause excitation of atoms by collision, and where there will thus be an increase in the radiation emitted. Many of the features associated with this radiation—its elevation in the chromosphere, location with respect to spots, stationary nature and association with changing sunspots—are similar to those of chromospheric flares, and it is therefore suggested that the above mechanism is responsible for these flares.

The transient nature of the flares may have several explanations. It may be due to temporary increases in the rate of growth of a spot, or to changes in the magnetic field, for example, location of neutral points, in the vicinity of a spot.

Similarly, the more frequent occurrence of flares in γ- than in β-groups may be attributed to either the greater number of suitable locations, such as neutral points, which must occur in these groups or greater fluctuations in the individual spots which make up the group.

The implications of the mechanism proposed above will be discussed in greater detail elsewhere.

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[2] Chapman, S., *Mon. Not. Roy. Ast. Soc.*, **103**, 117 (1943).
[3] Chapman, S., and Cowling, T. G., "The Mathematical Theory of Non-Uniform Gases", 327 (Cambridge University Press, 1939).
[4] Cillié, G. G., and Menzel, D. H., Harvard College Observatory Circular 410 (1935).
[5] Cowling, T. G., *Proc. Roy. Soc.*, **183**, 453 (1945).
[6] *Observatory*, **66**, 230 (1946).

NITROGLYCERINE AND GUN-COTTON: A DOUBLE CENTENARY

By Dr. J. WEIR
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A HUNDRED years ago there occurred a striking double event, the consequences of which could scarcely have been foreseen, even by the most imaginative visionary of the time: Ascanio Sobrero, professor of chemistry in Turin, discovered nitroglycerine, the basis of many modern explosives, both military and industrial; and C. F. Schönbein, professor of chemistry at Basle, discovered guncotton, which has also exerted a profound influence on the explosives industry, not only because of its military applications, but also as the forerunner of other similar nitrocelluloses which have had enormously wide applications in peace-time industries.

Nitroglycerine

Sobrero described the salient properties of nitroglycerine (which he called 'piroglycerina', and which is more correctly designated glycerine trinitrate), but it remained more or less a laboratory curiosity until Alfred Nobel turned his attention to it in the early 1860's. He and his father, Emmanuel, had been experimenting with nitroglycerine for some time, and like all the early experimenters with this dangerous liquid, had encountered several major difficulties in purifying, handling and transporting it. In 1863 the Nobels set up a new laboratory near Stockholm, and started a brilliant series of researches on methods of manufacture and of initiating and controlling the explosion of nitroglycerine. They also began to produce the explosive on a fairly large scale; but a serious explosion wrecked their laboratory, killing Nobel's younger brother and four others, and brought on his father a paralytic stroke, from which he never fully recovered. Thereafter, Nobel was prohibited by the Swedish Government from manufacturing nitroglycerine near the city, but he had such an abounding faith in his product and his methods that he hired a barge, anchored it in a lake two miles from Stockholm and carried on.

Nobel made four major inventions in connexion with nitroglycerine, three in the industrial field and one in the military field.

(1) He made the transport and use of nitroglycerine immeasurably safer by absorbing it in a light earthy substance called kieselguhr to produce the well-known 'dynamite'.

(2) He found that nitroglycerine could not be readily initiated or exploded by application of a flame, as ordinary black-powder could. He discovered, however, that by enclosing a sensitive explosive, such as fulminate of mercury, in a metal tube or capsule embedded in the nitroglycerine or dynamite, the whole mass could be brought to detonation by setting off this tube, or detonator as it is now called. Owing to the very much increased speed of this detonation phenomenon compared with that of the rapid burning of black-powder, a source of power of a magnitude hitherto unknown became available for man's use.

(3) He found that collodion (a form of nitrated cotton) dissolved in nitroglycerine to form a semi-solid jelly-like mass, and thus gave to the world its most powerful industrial explosive, 'blasting gelatine'. The story goes that one day Nobel cut his finger, and, in order to form a protective coating for the wound, he applied some collodion solution. The pain of the wound kept him awake at night pondering the problem of getting a more active absorbent for nitroglycerine than the inactive diluent kieselguhr. It occurred to him that collodion, which was a nitrated product from cotton, chemically not unlike nitroglycerine, might serve the purpose. He went to his laboratory, tried out the experiment, and to his intense satisfaction found his fondest hopes realized.

(4) His fourth and in some ways his most astonishing achievement was the invention of 'ballistite'. His study of celluloid led him to try the replacement of the camphor therein by nitroglycerine. He thereby obtained a colloidal mass which he found suitable as a propellent explosive. That two violent and detonable explosives, such as nitroglycerine and nitrocellulose, could be combined to form a propellant of controlled rate of combustion seemed almost impossible; but Nobel did not seem to have the word 'impossible' in his vocabulary. His dauntless courage and fertile imagination, born of genius and the clear flame of science, places him in a position of undoubted supremacy amid the great master minds in the modern explosives industry.

As a result of the Nobel inventions, a new world industry started, and dynamite factories sprang up all over Europe and America during the 60's and 70's of last century. In Great Britain he was personally associated with the setting up of the Ardeer Factory in Ayrshire, which has grown to be one of the largest explosives factories in the world and is now under the control of Imperial Chemical Industries, Ltd.

The advent of these powerful nitroglycerine explosives, which owing to their high velocity of detonation were able to produce effects of a different order of magnitude from those obtained by the centuries-old black-powder, gave a tremendous impetus to the industrial revolution which was already in full blast. The enormously increased power, made available in a usable and easily transportable form, not only diminished the time required for many engineering works, but also enabled man to undertake projects which owing to his previous physical limitations were considered impossible. These explosives have multiplied his resources and cut down costs by their greatly increased yields over manual labour in the winning of ores and coal and in quarrying. As an instance of the laboriousness of previous methods depending on the pickaxe, the hammer and the wedge, it took, in the old days, 150 years to mine five miles of gallery in the Harz Mountains. By modern methods, utilizing high explosives, this work could now readily be done within five years. But for these modern high explosives, the building of highways, railways, canals, tunnels and aqueducts, the deepening of water-ways, the removal of obstructions to navigation, the clearing of forest or boulder-strewn lands, the reclaiming of swamps (all essential to our present state of civilization) would have been greatly restricted. The records of the discovery, manufacture, transportation and use of nitroglycerine explosives are replete with romance, and the wonder of it all has inspired many to refer to dynamite as the 'New Aladdin's Lamp'.

A few examples of the industries which have progressed amazingly as a result of the assistance of nitroglycerine explosives may be given.

Coal-mining, the largest section of the mining industry, shows a steep rise in the production curve during the fifty-year period ending 1920. This is

largely attributable to nitroglycerine explosives, the production curve of which followed a parallel course. The effect of the greater ease of production and increased output of coal on the iron and steel industries can scarcely be over-estimated. The limestone industry, second only to the coal industry in tonnage production, likewise owes a great debt to modern explosives.

The development of the electrical industry during the last few decades of last century was largely dependent on copper. The magnitude of that development would not have been possible unless modern high explosives had been available to blast out the copper ore economically in quantities hitherto unheard of. Similar developments took place in the mining of other metallic ores, such as those of lead, zinc, aluminium, nickel and silver; and it needs little imagination to visualize the tremendous impetus given to various industries when these metals became available in quantity at relatively cheap prices.

Reference must also be made to the gold-mining industry. The value of explosives to this industry is perhaps best shown in the gold mines of South Africa, the world's largest producing centre. Here the mining is all in deep deposits of metalliferous rock, and it is certain that but for the invention of modern high explosives it would have been impossible to tap economically this immense source of wealth.

The oil industry uses large quantities of nitroglycerine explosives, not only in the modern methods of searching for oil deposits, but also in the so-called oil-well 'shooting', where the explosives are employed to shatter the underground formation and thus open up fissures through which the oil may flow freely to the well.

It may thus be claimed that the advent of nitroglycerine and the development of modern explosives containing it, though not primarily responsible for the industrial revolution, played a leading, if not a decisive, part in making that revolution a complete victory over man's physical limitations.

In the foregoing, stress has been laid on the use of nitroglycerine in industrial explosives for constructive purposes, and to the amazing progress that has taken place in that field during the past century. This has been done intentionally, because, when the word 'explosives' is mentioned, the man in the street almost invariably thinks of the destructive effect of military explosives. While Alfred Nobel did not neglect the field of military explosives, as instanced by his invention of ballistite, he undoubtedly had much more prominently in his mind the potentialities of nitroglycerine for industrial purposes; his endowment of the fund to provide, among others, the Nobel Peace Prize, is evidence in this direction.

Guncotton

Guncotton was discovered in 1846 by Schönbein when he was investigating the action of nitric acid on cotton in the presence of sulphuric acid. Although this was not quite the first preparation of any nitrocellulose, since Pélouze had prepared an explosive from nitric acid and cotton in 1838, it was the first practical preparation, because Pélouze had omitted the very important step of including sulphuric acid in his mixture, and no practical results followed from his experiments.

Once Schönbein had made his discovery, it did not take long for developments to ensue. He came to Britain in the autumn of 1846, and gave very successful demonstrations of the new explosive. He took out a British patent for it, and entered into an agreement with John Hall and Sons of Faversham by which they were granted the sole rights of manufacture at their powder works. It says much for British enterprise that Hall's were so ready to take up the new and practically untried explosive, and one regrets that this enterprise met with such an unfortunate result. On July 14, 1847, there was a disastrous explosion which killed twenty-one workers and destroyed the factory. Other explosions occurred at Vincennes and Bouchet in France, with the result that manufacture was discontinued in France and Britain for a period of about sixteen years.

In the meantime, however, work was being carried out in Austria on improved methods of purification. Trials were carried out with guncotton as a propellant, as at this time the distinctive characteristics of the different classes of explosives were only very vaguely recognized, if indeed they were recognized at all. It was found that the explosive was so violent that the guns were liable to burst or to be seriously damaged. Finally, after several explosions of Austrian magazines in which guncotton was stored, the Austrian authorities decided to discontinue production of the explosive, and all further trials of it in Austria were stopped in 1865.

Even before this time, the memory of earlier disasters in Britain and France had faded, and von Lenk, who had been responsible for the work in Austria, was able to persuade the British and French authorities to take a renewed interest in guncotton as a military explosive. Manufacture was begun at Stowmarket, but was again unfortunately—but perhaps not unexpectedly from our present knowledge—interrupted by an explosion. Simultaneously, small-scale work was undertaken at the British Government's factory at Waltham Abbey, under the direction of Frederick Abel, and it was his classical researches which elucidated the conditions necessary to ensure the chemical stability of guncotton. This work may be said to have placed the whole production of this most important chemical on a sure foundation.

The essential feature of Abel's work was to show that, by the process of 'pulping', guncotton was produced in a form which could be much more readily purified than if such treatment were omitted. The impurities were comparatively easily removed by washing the pulped material. Thus, although the modern process of nitrocellulose stabilization and purification had not been quite reached, one of the most important principles, the thorough removal of acidic impurities from the finished product, had been laid down, and means had been evolved whereby it could be accomplished. The pulped form of Abel's guncotton was convenient for pressing into blocks, and these compressed charges were tried in guns. It was found, of course, that the material was still excessively violent in its action, and no satisfactory means could be discovered to control the violence of the explosion. The use of guncotton as a propellant was therefore abandoned.

However, considerable progress was made in the application of guncotton as a demolition charge, when it was found by Abel's assistant, E. A. Brown, that dry compressed guncotton could be made to explode very violently by means of a detonator containing mercury fulminate. This method had, of course, already been used by Alfred Nobel for detonating nitroglycerine, and is of fundamental importance. A further very important discovery, also made by

Brown, was that water-wet guncotton could be made to detonate by means of a small primer of dry guncotton, which had in its turn been set off by a mercury fulminate detonator. This arrangement was a considerable advantage from the military point of view, because it meant that the great bulk of the explosive could be transported and stored in a very insensitive form, and only after insertion of the sensitive dry guncotton primer was the material really hazardous, and then only if the primer itself were submitted to shock or friction. The foundations were thus laid for the production and use of guncotton as a military explosive.

During the years that followed, a vast amount of investigation was carried out on the subject of the nitration of cellulose. This work was by no means confined to the possible military applications of nitrocellulose. Every possible aspect of the new chemical was examined and tested, and the result was that an enormous and expanding field of application was found. It soon became apparent to the investigators that the so-called guncotton was only one of the possible products of nitration of cellulose, and that by varying the conditions of production, a wide range of products could be obtained. All these were, of course, nitrocelluloses, or, more correctly, cellulose nitrates ; but they differed from each other in their nitrogen contents, in their solubilities in different solvents and in the viscosities of their solutions. These differences had a profound effect on the applicability of the different types of nitrocelluloses to the numerous uses which were to be discovered.

A range of nitrocelluloses was produced, having nitrogen contents from about 10 per cent to more than 13·4 per cent, and viscosities from a free-flowing 40 per cent solution to a stiff jelly in 3 per cent solution.

The nitrocelluloses were shown to be applicable, not only as military high explosives, but also, in admixture with nitroglycerine, as explosives for commercial blasting and special military applications ; and also for the production of the propellants—cordite, nitrocellulose powder and smokeless shotgun powders. These examples are all in the explosives category, but the applications in other industries are no less extensive.

Quite apart from its explosive properties, nitrocellulose has special characteristics which render it unique in the chemical field. Its outstanding feature is to give, in combination with suitable plasticizers, hard and tough films and plastics. Celluloid consists of nitrocellulose and camphor, and is well known for its resistance to wear and to many chemicals. Nitrocellulose paints and lacquers have established for themselves a high reputation for quality and lasting properties. Leathercloth based on nitrocellulose is well known to be of high quality and reliability. Apart from these uses there are numerous other applications, including varnishes, adhesives and surgical uses.

Mention must also be made of Chardonnet's invention of a so-called artificial silk based on nitrocellulose, solutions of which were spun into fibres, which were then denitrated. His process has, of course, been superseded, but his work laid the foundations of a great and universally beneficial industry.

In this era of progress we leave behind the old and move on to the new, but at the moment the century-old nitroglycerine and military guncotton, with its industrial counterpart, are still well to the fore, and seem likely to remain so.

NUTRITIVE VALUES OF FOODS AND CONDIMENTS

AT a meeting of the Nutrition Panel of the Food Group of the Society of Chemical Industry at Burlington House, London, on May 29, four papers, together covering the nutritive values of vinegar, pickles, condiments, margarine, edible fats, nuts and meat extract, were read to an appreciative audience.

Mr. H. S. Sarson opened by confessing that the attempt to assess "The Nutritive Value of Vinegar, Pickles and Condiments" put him on the horns of a dilemma : whether to emphasize analysis or cookery. Viewed analytically, the substances seldom show impressive results ; nevertheless many are of high nutritive value. Vinegar, for example, is more than a digestive stimulant ; it contains phosphorus, nitrogen and the B vitamins. Not only in Roman times, but also until a hundred years ago in Great Britain, fruit vinegars, sometimes flavoured and sweetened, were popular summer drinks.

Pickling, originally a method of preserving summer foods for winter use, was restricted to condimental use with the development of agricultural methods. But even to-day it is difficult to say whether *sauerkraut* and pickled herring are preserved foods (in both cases the nutritive elements are considerable) or just pickles. The food value of sauces, especially fruit sauces, is obviously high ; normally, however (excepting predatory small boys !), one eats nutritively insignificant quantities per day. Salad creams are in a similar position, although in summer-time the daily intake may assume nutritive importance. Jams and preserves present an inverse example ; normally contributing usefully to the diet, they are occasionally used purely as condiments (for example, red currant jelly with roast mutton).

Analytically, then, there is no strong case for the value of pickles, sauces, spices, etc., and deprivation would not cause deficiency diseases. Yet they have what it is not unfair to call essential roles in cooking throughout the world, in so far as a completely ungarnished diet would be grim and monotonous.

There is a curious specificity about 'the little more and how much it is', a peculiar 'just rightness' about, for example, chips *plus* vinegar, or pheasant *plus* bread sauce (and what is it that 'makes' bread sauce but the smell of onions and the taste of cloves ?). Most efforts to alter, extend or shuffle such time-honoured combinations have failed, although new combinations are still being unearthed. Less than twenty-five years ago an American found that the best salad to accompany roast chicken is pineapple. One notes a semblance of orderliness about these combinations ; for example, sharp sauces for fatty foods, sweet things with carbohydrates ; and the general rule applies, the more highly flavoured the bulk food the stronger must be the condiment. Condiments are best regarded as nutritional catalysts, substances that may be (although by no means invariably) inert in themselves, but the presence of which renders food more appetizing and therefore more beneficial. Their place in the national dietary is of great importance.

"The Nutritive Value of Margarine and Edible Vegetable Oils" was then dealt with by Dr. H. Wilkinson, who began by grouping these food materials as follows : (*a*) oils extracted from oil seeds, then refined and deodorized, (*b*) the same oils hardened by hydrogenation, (*c*) blended oils as used in margarine

and cooking fats. Group (*c*) may be subdivided into (i) mixtures of a small amount of hardened fat in a preponderance of liquid oil (this yields a creamy product) and (ii) mixtures simulating in texture and analysis some natural product.

The commonest edible oils used in Great Britain are ground-nut, palm kernel, palm, cotton-seed, coco-nut and soya bean. Their nutritive value can be considered either purely in terms of available energy or, additionally, in terms of vitamins and essential fatty acids. If available energy is to be the sole criterion, we must, of course, assume that the diet is complete in all other respects. The controlling factor is then net absorption. Oils in group (*a*) (above), and moderately hardened oils (m.p. 32–42°C.), are absorbed to 96–99 per cent, while highly hardened oils (m.p. 46–48° C.) are absorbed to 91–94 per cent. The absorptions of mixed oils are usually the weighted means of those of the components, although certain blended and emulsified mixtures (for example, margarine) are better absorbed than the individual components. The fact that the vegetable oils normally used in Great Britain have net absorption figures higher than 90 per cent is satisfactory, in so far as it is unlikely that less than 10 per cent of unabsorbed fat will cause digestive disorders. The calorific value of all such oils falls within the range 8,100–9,100 calories per kilo.

Some oils, used more extensively outside Britain, are reported to have digestibilities of less than 90 per cent. Cocoa-butter has been the centre of some controversy in this connexion, figures of below 90 per cent and above 95 per cent having been reported. Finally, there are certain types of hardened oils (not encountered in Britain) with low digestibilities.

Passing on to the other aspects of nutritive value, Dr. Wilkinson said that while the fats under discussion are, on the whole, free of vitamin-A precursors, they are often rich in vitamin E. What are termed 'essential fatty acids' (linoleic, arachidonic and possibly linolenic acids) are also abundant, although a full account of these factors and of vitamin E in edible oils is not yet available. Palm oil is in a class by itself, and in certain parts of the world it supplies almost the only source of vitamin-A precursors for humans.

Margarine is, of course, a special case so far as vitamins are concerned, because manufacturers in Britain are bound by law to add 550 I.U. of vitamin A, and 90 I.U. of vitamin D, per ounce.

The seed-like structures known as nuts, began Dr. R. Melville, speaking on their nutritive value, are in general highly nourishing, although detailed analyses are still lacking in many cases. Only some of the better known kinds can be dealt with here.

Most nuts are principally valuable as sources of oil and protein, but some have starch as their main food reserve. A well-known example is the sweet chestnut, containing 75 per cent starch (all analytical data on nuts are based on dry weight); others are the acorns, the water chestnut, certain water-lily seeds (including those of the sacred lotus of India and the giant Amazon water-lily), the once-popular 'tiger nut' (swellings on the rhizomes of a pan-tropical water sedge), the seeds of certain pines, and the kernels of the maidenhair tree (*Ginkgo*). Two leguminous seeds, the Yeheb nut and the Bambara ground-nut, also fall into this class.

'Oily' nuts form a larger and more important group. Prominent members are the Juglandaceæ such as walnuts, pecans, hickory and others, containing 59–74 per cent fat, and in one instance, the butter-nut, as much as 29 per cent protein. The Rosaceæ (almond, peach, plum, etc.) all contain more than 40 per cent fat and 22–33 per cent protein. Into the same analytical class come beech nuts (47), Barcelona nuts (67), cashew nuts (47), pistacio nuts (56), many pine nuts (48–79), the Pili nuts (75), Brazil nuts (68), pea-nuts (47), coco-nuts (65) and palm nuts (53)—the bracketed figures give percentage fat. Many of these are also rich in protein—the nuts of the stone pine and pea-nuts containing more than 30 per cent. A few of the Cucurbitaceæ yield edible seeds that may be grouped with the foregoing examples; for example, marrow and melon seeds, containing between 30 and 50 per cent fat, are regularly eaten in China, Africa and elsewhere.

As will be seen from the data, many nuts make an approach to a well-balanced ration so far as protein, fat and carbohydrate are concerned. But so far as vitamin contents are concerned our knowledge is still incomplete. There is evidence that nuts generally are good sources of vitamin B_1, and probably other members of the B complex. The pecan, pea-nut, and Brazil nut are particularly rich in vitamin B_1, contents of the order of 10 μgm. per gram having been recorded. Carotenoids, precursors of vitamin A, are present in some nuts, particularly high values (10 I.U. per gm.) being noted in some walnuts.

Walnuts are also conspicuous among the several nuts known to contain vitamin C, because it has been discovered that the vitamin-C content of the mature kernel is low, and that of the immature green fruit exceptionally high. The endocarp, which is embryonic shell, is initially rich in vitamin C, but the potency falls as the shell develops, and it is possible that the woody material of the shell is built up from vitamin-C-like units. The nuts are richest just prior to the hardening of the shell; in this condition they are gathered for pickling, although if they are pickled to blackness the vitamin C is destroyed. They should therefore be 'green pickled'. More than 1 per cent of vitamin C by weight has been found in walnuts at the appropriate stage of development.

Drs. A. H. Salway and H. G. Rees introduced their paper on "The Nutritive Value of Meat Extract" by recalling that Liebig's original preparation, first marketed about the middle of the nineteenth century, enjoyed considerable popular, but meagre scientific, esteem as a nutrient. The strictures of the experts were of course based on the current belief that nutritive value could be assessed solely in terms of proteins, fats and carbohydrates. It is noteworthy, however, that Liebig himself emphasized the effects of meat extract in promoting the appetite and stimulating the gastric juices. Both these suggestions have since been experimentally substantiated by, for example, Pavlov and, more recently, Fisher and Appleby (*J. Lab. Clin. Med.*, 26, 823; 1941), while the physiological benefits of appetite-promoters such as meat extract have always been recognized by dietitians.

An early claim made for meat extract was its ability to assist muscular effort and to increase stamina. The military hygienists of last century certainly believed in, and acted upon, this claim. Nevertheless, in the absence of scientific evidence, this aspect of meat extract had many opponents. But here again supporting evidence is now accumulating.

Analytically, meat extract is extremely complex, and our knowledge is still incomplete. But the

available information indicates a variety of nutrients the presence of which goes far to explain many of the early claims. True, the albumoses and allied compounds, constituting about 14 per cent of the material, although supplying first-class protein, are of small quantitative significance in the diet. But the meat bases, creatine, creatinine, carnosine, anserine, purines, glutathiones and others, which together account for nearly 30 per cent of the total, are known to stimulate the flow of gastric secretions, to effect muscle metabolism, and to spare proteins from the task of supplying creatine.

It is, however, the vitamins of the B complex in meat extract that are of especial interest and importance.

VITAMIN-B COMPLEX IN FRESH BEEF AND BEEF EXTRACT (EXPRESSED AS μGM. PER GRAM)

	Beef	Beef extract
Vitamin B_1	0·9–3·0	0–1
Vitamin B_2	1·8–3·5	30–35
Nicotinic acid	24–102	1000–1200
Pyridoxine	0·77–4·0	5
Pantothenic acid	4·9–15	25
Choline	760	?
Biotin	0·02–0·03	?
Folic Acid	1·0	?
Inositol	115	?

It will be seen that the concentration of many, although not all, of these essential nutrients is high. A few grams of meat extract per day will supply no inconsiderable part of the daily requirements of the B complex. For example, a third or more of the nicotinic acid requirement is contained in 3–4 gm. of meat extract. This, coupled with the fact that nicotinic acid is now known to be concerned with stamina and mental alertness, provides a further instance in vindication of early claims. Finally, the close relation between the B vitamins and a healthy blood picture no doubt explains why meat extract has long been regarded as 'good for the blood'.

A short but interesting discussion followed, the most notable part of which centred on the vitamin-C content of walnuts. The chairman, Mr. A. L. Bacharach, asked Dr. Melville whether the vitamin-C content of walnuts increased significantly during germination, and if so, whether the shell, which Dr. Melville had envisaged as built up from vitamin-C-like molecules, might, in its immature stages, be the source of the vitamin C. In reply, Dr. Melville said that no work on germination had yet been carried out, but the suggestion would be borne in mind.

OBITUARIES

Prof. W. B. Cannon, For.Mem.R.S.

By the death on October 2, 1945, of Walter Bradford Cannon, the United States and the world lost one who, for a whole generation, had been recognized as a great leader in his own chosen scientific field of physiology. Cannon was born on October 19, 1871, at Prairie du Chien, Wis., and received his schooling at Milwaukee and St. Paul, Minn. Entering Harvard in 1892, he remained with that University and its Medical School until his retirement in 1942 from the chair of physiology, to which he had been appointed in 1906; so that his association with Harvard, as student, graduate, instructor and professor, extended over just half a century.

One of Cannon's most practically fruitful discoveries, and the one from which he could trace, in logical sequence, the development of his later interest in other fields of research, was made when he was still a young graduate, beginning research in the Department of H. P. Bowditch, through whom Cannon could claim to be a 'scientific grandson' of Carl Ludwig. Röntgen's discovery of X-rays was a novelty, and Cannon was interested in using them to render visible, on a fluorescent screen, the passage of a metal ball down the œsophagus of a goose. The idea of mixing with food an insoluble bismuth salt, opaque to X-rays, presented itself to Cannon. With this technique he was able to follow the progress of a meal and its products through the alimentary canal of the normal cat; and thus he not only provided invaluable data for the normal physiology of digestion and absorption, but also furnished to medicine and surgery the principle of one of the most powerful items of modern diagnostic equipment.

In these studies on the visceral movements of a normal, un-narcotized cat, Cannon was early struck by the effects on them, and particularly the immediately depressant, inhibitory effect, of emotional excitement—reactions to sudden noises, or to any cause of fright or anger. These observations, in connexion with evidence then coming from other research centres, led Cannon to enter upon a long and fruitful series of researches on the sympathetic nerves and the control by them of the output of adrenaline from the suprarenal medulla, and on the physiological significance of a sudden output of adrenaline into the circulation, as providing favourable physiological conditions for effective flight or combat. The general outcome of this series was summarized by Cannon, for a circle wider than that of the specialists, in a book, now well known, on "Bodily Changes in Pain, Hunger, Fear and Rage".

Through these studies of the physiological concomitants of emotional reactions, Cannon became interested, as Claude Bernard had been before him, in the accuracy with which the mechanisms of adjustment at the disposal of the living body keep such physiological factors as the content of sugar and the alkalinity of the blood at constant average levels, restoring them rapidly thereto after functional fluctuations. Out of such further studies grew another book, of even wider appeal and more broadly philosophical outlook, entitled "The Wisdom of the Body".

In May 1917 Cannon was a member of the Harvard Hospital Unit which arrived, in advance of the American Army, to play its part in the War in France. After working at a casualty clearing station at Bethune, and gaining direct experience of the physiological factors involved in wound shock, he came to England in November of that year, and engaged, in collaboration with the late Sir William Bayliss, in laboratory experiments arising from his observations in the field. Out of this collaborative experience, together with the exchanges and discussions across the table of a Committee on Wound-Shock then sitting in London, came another book by Cannon. Whatever may be the permanence of results thus snatched to meet war's urgent demands, the experience gained, as Cannon himself was later to claim, helped to re-open an attack on such problems when a second world war made its new demand.

Through his studies on sympathetic and adrenal adjustments of bodily function, Cannon was led to his last main series of researches, dealing with the transmission of nervous effects by chemical agents. Observations of the transmission by the blood, to a

denervated heart, of effects produced by stimulation of distant sympathetic nerves, would seem to have led him to the verge of a discovery which O. Loewi was to make, just at this juncture, by a simpler and direct method. In Cannon's remaining active years he was largely concerned with evidence as to the nature of the sympathetic transmitter 'sympathin', which he believed to be not identical with adrenaline.

No mere account of Cannon's varied and uninterrupted contribution to the growth of physiological knowledge, over all these years, can give any adequate idea of the man, or of his stimulating influence on scientific research in his own country and widely beyond it. His character was drawn on large and simple lines; he was capable of deep and loyal friendships, and readily moved to sympathy and indignation by suffering and injustice. He was a man of sensitive conscience, full of the traditions and the ideals of his native land. He has himself attributed high importance to physical health as a factor of success in an investigator; and in his youth he must have had great strength and endurance. From middle life onwards, however, his health was marred by various allergies, and eventually by a slowly malignant condition, which he suspected to be an after-result of his early experiments with X-rays, in the days before the potential dangers of these were known. His work, however, seemed to be little affected by conditions which must greatly have interfered with his bodily ease and broken his rest.

Cannon was early married to Cornelia James, who had been his schoolfellow. Apart from her own literary activities and social work, Mrs. Cannon shared intimately in her husband's interests, and their household, with a son and four daughters, was radiant with affection and quiet happiness. Cannon's last book, "The Way of an Investigator", is a delightfully discursive talk on the life of research and on the genesis of scientific discovery. It has an autobiographical basis, and an intimate and ingenuous quality which allows a friend almost to hear the tone of Cannon's voice as he reads. H. H. D.

Mr. J. L. Baird

John Lodie Baird, a pioneer of television, died on June 14, at the age of fifty-eight, after an illness which began in February, up to which time he had been actively engaged in research in various problems in television in the laboratories of his own company.

Baird was the son of a Scottish minister and received his scientific education at the Royal Technical College, Glasgow, where he won an associate scholarship in electrical engineering. Experimental research had always been his hobby, and in the early days of his training he devised an improved pattern of selenium cell, which led him to develop a crude form of television.

When Baird was compelled by ill-health to abandon an active business career, he devoted himself exclusively to a study of the problem of television. He became a pioneer in this field in the early days of sound broadcasting, and was undoubtedly responsible for initiating public interest in this art.

The basic problem of television, as it was correctly appreciated by Baird, consists in the provision of means for scanning an image by subdividing it into tiny elements, transforming the resulting light variations into electrical impulses for transmission by line or radio to the receiver, where the impulses are reconverted back into light for the reconstruction of the picture. Some means for synchronizing the transmitter and receiver must also be provided. For the scanning process, Baird first used a revolving disk carrying a series of suitably placed lenses, and a synchronously driven disk at the receiving end. Very intense illumination was required on the subject to be televized, while the variation in the illumination obtained from a neon lamp was used to reproduce the picture at the receiving end. Working on these lines, Baird gave a demonstration of television on January 27, 1926; this was claimed to be the first demonstration of true television ever witnessed. The original apparatus was afterwards exhibited in the Science Museum at South Kensington.

In the following years, many details of the system were improved and are described in a series of patent specifications. These covered such items as the means of illumination of the subject and even of the use of infra-red radiation to reduce the glare, which the subject found to be unpleasant; accurate methods of synchronizing transmitter and receiver; and an increase in the rapidity of scanning with a corresponding improvement in the definition of the reproduced pictures. Baird's demonstrations of the possibilities of television by radio led to the successful transmission of television across the Atlantic in February 1928, followed a few weeks later by experiments on board s.s. *Berengaria* while the receiving equipment was being brought back from New York.

The first step towards the inauguration of a television service in Great Britain was taken in 1929, when the B.B.C. decided to give Messrs. Baird Television, Ltd., facilities for experimental transmissions through the medium-wave London station. These transmissions, which were afterwards referred to as 'low-definition', employed 30 scanning lines and 12½ pictures per second, the programmes originating in the Baird studios in Long Acre, London. After about a year, these 30-line transmissions were considered to be of sufficient technical interest for the B.B.C. to equip a studio in Broadcasting House with Baird apparatus; and this was put into use in 1932. At this time the development of improved standards of definition was progressing rapidly, and several organisations were experimenting with systems using 120 lines.

In May 1934, the Postmaster-General appointed a committee to report on the relative merits of the several systems of 'high-definition' television, and to consider the conditions under which a public service might be provided using ultra-short waves to accommodate the large band-width necessary for the transmission of such systems. Among the Committee's recommendations was one to the effect that the first station should be in London, and that the two selected systems, Baird and Marconi–E.M.I., should each supply their own apparatus for alternative operation; the cost being borne by the revenue from the existing licence fee. Accordingly, towards the end of 1936, a public service was opened from Alexandra Palace, the two systems of transmission being used in alternate weeks. The Baird system provided 240 lines, 25 pictures per second with sequential scanning; whereas the Marconi–E.M.I. system used 405 lines, and 25 pictures per second with interlaced scanning. After a few months' experience, the Television Advisory Committee recommended that the experimental period should be terminated, and that the standards to be adopted for the London station should be those provided by

the Marconi–E.M.I. system, which is in use in the recently re-opened service from Alexandra Palace.

During all these years and until a few months before he died, Baird continued to work steadily towards the improvement of the scope and possibilities of television and its presentation. The system which bears his name had early taken advantage of the cathode ray tube for reception of the transmitted picture; and in December 1937 he demonstrated in London the optical projection of television pictures on to a cinema screen. The possibilities of introducing colour and stereoscopic effects had for many years also aroused his interest, and in 1944 he gave a demonstration of his recent achievements in the reception of television in colour by a method which avoided the need for revolving disks and lenses.

Altogether Baird played a notable part in stimulating the development of many aspects of television technique, and undoubtedly contributed materially towards the success attained by radio engineers and physicists, resulting in Britain being in the forefront of the world in this fascinating application of electromagnetic waves. R. L. Smith-Rose

Prof. Amadeus W. Grabau

Amadeus W. Grabau was born of German stock at Cedarburgh, Wisconsin, on January 9, 1870, his father and paternal grandfather being Lutheran Church pastors. His grandparents had left Germany in the middle of last century to seek refuge in the United States from persecution for refusal to conform to the practices of the reformed Lutheran Church. Perhaps it was this ancestry which bred in Grabau that stubbornness and refusal to accept current geological dogma without challenge which characterized his career. His radical opinions, expressed with a forthrightness not always to the liking of more conservative minds, touched not only American and Asian geology, but also impinged forcibly on the fundamentals of world geology.

At the age of fifteen, Grabau was apprenticed to a bookbinder in Buffalo, N.Y., but he continued his education at evening classes, discovering the delights of botany and geology. His ability in a correspondence course in mineralogy led Prof. W. O. Crosby, of the Massachusetts Institute of Technology, to offer him in 1890 a post at the Boston Society of Natural History and a special studentship at the Institute. The young man now came into contact with a brilliant gathering of teachers and he responded readily to their influence. His interest in physiography was sharpened, but to it was added a lively knowledge of marine bionomics and, through Alpheus Hyatt and R. T. Jackson, of palæontology. He graduated in 1896, and entered Harvard University in 1897, where he took his master's (1898) and doctor's (1900) degrees. By way of Tuft's College, the Rensselaer Polytechnic Institute and the Geological Survey of Michigan, Grabau passed to a lectureship in palæontology at Columbia University in 1901, becoming full professor in 1905.

Grabau had already published a number of studies on Pleistocene geology, such as "The Pre-Glacial Channel of the Genesee River" (his first paper) and on glacial phenomena of Cape Cod and of Glacial Lake Bouvé. But the richly fossiliferous Lower Palæozoic and Devonian rocks of New York State were an equal attraction, and he published papers on their faunas. In addition, he speculated (sometimes from unsound premises, as with the Fusidæ) on the phylogeny and bionomics of the fossil groups—Devonian fishes, Palæozoic corals and coral reefs, graptolites, gastropods, etc., all passed beneath his scrutiny. These essays were related to numerous others on the classification, nature and formation of sedimentary rocks and of salt deposits; for example, his book "Geology of the Non-Metallic Mineral Deposits other than Silicates. Vol. I. Principles of Salt Deposition" (1920). Grabau's widely ranging interests in stratigraphy, palæogeography, palæontology and sedimentation were, however, inter-related in his mind, and were synthesized into a whole in his "Principles of Stratigraphy" (1913). He stoutly advocated his views at meetings of the Geological Society of America, where his clashes with E. O. Ulrich and A. E. Foerste, who held other opinions equally strongly, became legendary. But the storms of the meeting-room were always followed by peace-making discussions afterwards.

The War of 1914–18 brought a crisis in Grabau's affairs. In an America where the teaching of German at public schools was banned and where streets and places with German names were re-christened, any defence of German literature, arts and science could not be tolerated. But Grabau commended these contributions to world culture, stubbornly refused to explain his views more fully, and ultimately left Columbia. China seized the opportunity and offered him the post of chief palæontologist to the National Geological Survey of China and professor of palæontology at the National University of Peking, which he accepted in 1920.

Grabau plunged with vigour into his new tasks, and quickly built up a flourishing school at the University of Peking. The mass of palæontological material in the collections of the Survey was a mine he explored eagerly. The faunas of China were revealed, with adequate descriptions and figures, in a flood of monographs and papers by Grabau and by students he had trained. His own palæontological contributions were more particularly on the Palæozoic corals and brachiopods, though they embraced other groups from almost every age, and inevitably included discussions of their bionomics. The implications of this work on Chinese stratigraphy were quickly grasped by Grabau, and within four years of his arrival in that vast country he issued the first volume of his "Stratigraphy of China" (volume 2 came out in 1928), wherein he put forth new hypotheses to solve the difficult questions, while he later published a series of papers on "Problems in Chinese Stratigraphy". His "Permian of Mongolia", volume 4 of "Natural History of Central Asia", was the vehicle for a discussion of the Permian of the world, where his original ideas once more coloured a long-drawn-out debate. He held strong views on the migration of geosynclines, and in a number of papers on the pulsation theory strenuously advocated universal transgression and regression for a given geological period. His "Rhythm of the Ages", published in 1940, is characteristically stimulating and full of ideas.

The Geological Society of China honoured Grabau by founding the Grabau Gold Medal, of which he was the first recipient in 1925, while later it celebrated his sixtieth birthday by dedicating volume 10 of its *Bulletin* to him. Its preface, signed by the eight leading Chinese geologists, is a moving testimony to the regard which he had won in his adopted country by the same inspiring enthusiasm, kindly under-

standing and homely hospitality that are not forgotten by his old American students.

In 1933 Grabau re-visited America and was pleased at his welcome and at renewing personal contact with his old friends and antagonists, Foerste and Ulrich. Though some of the old narrow prejudices persisted even later in some quarters, this visit did much to relieve the mental suffering he had so long endured. By then he was already painfully crippled by rheumatism which progressively worsened. He kept bravely on, however, and it is remarkable that such a mass of research work and of ideas could have been produced by one who suffered so severely. The Japanese invasion of China brought increasing difficulties to Grabau. When the Geological Survey and the National University of Peking moved to Kunming, Yunnan, in 1937, his illness forced him to be left behind; but he struggled on, formulating and publishing his ideas, while his Chinese friends got food and money to him whenever possible. After the Pearl Harbour incident, he was housed by the Japanese in the old British Embassy in Peking, but the lack of food and attention and his utter hatred of the Japanese aggression told heavily on the old man. He was very ill bodily and mentally when he was liberated in September, 1945, and despite the care of the authorities of the Geological Survey, he died on March 20, 1946, after internal hæmorrhage. He was a widower with one daughter.

H. Dighton Thomas

NEWS and VIEWS

Newton Tercentenary Celebrations

The three hundredth anniversary of the birth of Isaac Newton fell on December 25, 1942. At that time an international celebration to mark the occasion was out of the question, but the Royal Society devoted the greater part of its anniversary meeting on November 30 of that year to lectures on Newton and his work. Sir Henry Dale, who was president of the Royal Society at that time, spoke in general terms of the significance of Newton as an outstanding figure in the progress of Western science and philosophy. Lectures were given by Prof. E. N. da C. Andrade, Lord Rayleigh and Sir James Jeans, which we were able to print in *Nature* of December 19, with an article by Prof. S. Brodetsky on Newton as scientist and man. The Physical Society and other learned bodies also had special lectures.

As announced by Sir Robert Robinson in opening the Royal Society Empire Scientific Conference, the Society arranged to hold a celebration of wider scope which began on July 15. Delegates from many foreign academies were present and also representatives attending the recent Empire Scientific Conference. The delegates were welcomed by Sir Robert Robinson, who stated in the course of his address that the Royal Society has recently proposed to the British Government a scheme for an Isaac Newton observatory as a national memorial. The scheme provides for a 100-in. reflector and other modern astronomical equipment. The observatory would be the property of the Government, but it would be available for the use of investigators from other observatories. Among the addresses and gifts presented to the Royal Society on this occasion was a copy of a Russian translation of the "Principia" presented by the delegation from the U.S.S.R.

Other items from the programme of the week's celebrations were lectures by Prof. E. N. da C. Andrade on "Isaac Newton"; by the late Lord Keynes (read by Mr. Geoffrey Keynes) on "Newton, the Man"; by Prof. J. Hadamard on "Newton and the Infinitesimal Calculus"; by Academician S. Vavilov (read on his behalf) on "Newton's Atomism"; by Prof. Niels Bohr on "Newton's Principles and Modern Atomic Mechanics"; by Prof. H. W. Turnbull on "Newton: The Algebraist and Geometer"; by Dr. Walter Adams on "Newton's Contributions to Observational Astronomy"; by Dr. Jerome C. Hunsaker on "Newton and Fluid Mechanics". The King and Queen invited delegates to a garden party, and there were visits to the Covent Garden Opera House for a performance by the Ballet Theatre of New York, to Cambridge and the Royal Mint, and a reception by the Lord Mayor and Corporation of the City of London.

British Commonwealth Scientific Official Conference

Mr. Herbert Morrison, Lord President of the Council, opened the British Commonwealth Scientific Conference on July 9. He said that the Royal Society Conference which had just closed was an admirable preparation for the official Conference, in that it provided many opportunities for both formal and informal discussions. Mr. Morrison suggested that a guiding principle in dealing with any problem before the official Conference should be, first, what it is desired to achieve, and then how the desired results can be best brought about and what additional machinery, if any, is necessary for the purpose. It is possible, he warned, to pay too much attention to organisation. If there is the will to co-operate (and there is abundant evidence that this exists throughout the Commonwealth), then very frequently the means follow naturally. It is important to remember, he said, that throughout the British Commonwealth we shall be faced for some years to come with an acute shortage of scientific man-power; and there is a risk that too elaborate organisation may result in absorbing into the administrative machine many scientifically trained men who are badly needed in research laboratories. Careful distinction must also be made between subjects on which work can be safely left to develop along its own lines in the individual countries of the Commonwealth and Empire, and subjects in which successful collaboration demands closely similar methods being employed by all engaged in the work. In the former case, full collaboration can be achieved by ensuring that individual investigators, wherever they may be working, know what others are doing and are able to meet at intervals for discussion of results. The other type of work requires the adoption of concerted plans of action. Mr. Morrison pledged the Government to give most careful and sympathetic consideration to recommendations made by the Conference; and he declared that the Government is determined that science shall play its proper part in the formation

CIVIL SERVICE COMMISSION

The Civil Service Commissioners invite applications for the following posts in the Microbiological Research Department of the Ministry of Supply.

Post 1. Superintendent Bacteriologist. Candidates must possess first-class qualifications, wide experience of original research, special knowledge of immunology and capacity for supervising and co-ordinating research.

Post 2. Superintendent Biochemist. Candidates must possess first-class qualifications, wide experience of original research. special knowledge of bacterial chemistry and capacity for supervising and co-ordinating research.

Post 3. Principal Scientific Officer. Candidates must be Experimental Pathologists with good experience of original research. They must be qualified in medical science and preference will be given to those with research experience in bacteriology.

Post 4. Principal Scientific Officer. Candidates must be Bacteriologists with good experience of original research. They must be qualified in medical or veterinary science.

Post 5. Principal Scientific Officer. Candidates must be Experimental Physiologists with good experience of original research. They must be qualified in medical or veterinary science.

Post 6. Senior Scientific Officer. Candidates must be Biochemists and must have first-class qualifications together with research experience in bacterial chemistry.

Post 7. Senior Scientific Officer. Candidates must be Bacteriologists with a qualification in veterinary science and experience in research.

Post 8. Senior Scientific Officer. Candidates must be Biophysicists with high qualifications in physics and experience in the biological sciences.

Post 9. Scientific Officer. Candidates must be Biochemists with high qualifications and some research experience.

Post 10. Scientific Officer. Candidates must be Bacteriologists well trained in the basic sciences and should have some experience in bacteriological research.

Post 11. Experimental Officer. Candidates must be highly skilled in experimental bacteriology. They should hold the Diploma in Bacteriological Technique of the Institute of Medical Laboratory Technology, or equivalent qualification. Consideration will be given to candidates possessing alternative qualifications and/or special experience.

Post 12. Assistant Experimental Officer. Candidates must be skilled in experimental bacteriology. They should hold the Intermediate Examinations of the Institute of Medical Laboratory Technology, or equivalent qualification. Consideration will be given to candidates possessing alternative qualifications and/or special experience.

Salaries (Men):

Superintendent £1,200 × £50–£1,400 (less Provincial Differentiation which at present is £100 at the minimum and maximum of the scale).

Principal Scientific Officers £800 × £30–£1,100 (less Provincial Differentiation which at present ranges from £50 at the minimum of the scale to £80 at the maximum).

Senior Scientific Officers £550–£25–£750 (less Provincial Differentiation which at present ranges from £30 at the minimum of the scale to £40 at the maximum).

Scientific Officers £275 × £25–£500 (less Provincial Differentiation which at present ranges from £20 at the minimum of the scale to £30 at the maximum).

Experimental Officers £400 × £18–£550 (less Provincial Differentiation which at present is £30 at minimum and maximum of the scale).

Assistant Experimental Officers £150 × £15–£195 × £18–£350 (less Provincial Differentiation which at present ranges from £10 at minimum of scale to £30 at maximum);

plus consolidated addition in lieu of war bonus. The salaries for women are somewhat lower in all cases.

Posts 1–10 are permanent full-time appointments with superannuation provision under the Federated Superannuation Scheme for Universities.

Posts 11 and 12 are permanent full-time appointments whose holders will be pensionable under the Superannuation Acts.

Candidates must be of British nationality and not more than 50 years of age. They must possess the stipulated qualifications and experience and for posts 1–10, research ability.

Further details, together with application forms, may be obtained from the Civil Service Commission, 6 Burlington Gardens, London, W.1, quoting No. 1550, with whom completed applications must be lodged by September 10, 1946.

Bureau of Abstracts. Required Chief

Editor with qualifications in chemistry. Salary £800–£1,300 according to experience. Apply in writing by August 24, to Treasurer, Bureau of Abstracts, 41/43, Maddox Street, W.1.

UNIVERSITY COLLEGE OF SWANSEA

(A Constituent College of the University of Wales)

Principal: C. A. Edwards, D.Sc., F.R.S.

APPLIED SCIENCE DEPARTMENTS

Metallurgy

Professor: C. A. Edwards, D.Sc. (Manchester), F.R.S. Assistant Professor: R. Higgins, Ph.D. (Glasgow). Lecturers: R. Griffiths, M.Sc. (Wales); T. B. Wilkinson, Ph.D., B.Eng.(Liverpool), A.M.I.Mech.E., D. W. Hopkins, B.Sc. (Wales).

Engineering

Professor: R. N. Arnold, D.Sc.(Glasgow), Ph.D. (Sheffield), M.S.(Illinois), A.R.T.C., M.I.Mech.E., Assoc.M.Inst.C.E. Lecturer in Electrical Engineering: R. G. Isaacs, M.Sc.(Bristol), B.Sc.(London), A.M.I.E.E. Lecturer in Civil Engineering: A. A. Fordham, Ph.D.(London), Assoc.M.Inst.C.E., M.I.Struct.E. Lecturer in Mechanical Engineering: J. Selwyn Caswell, M.Sc. (Wales), M.I.Mech.E., Assoc.M.Inst.C.E. Lecturer: W. E. J. Farvis, B.Sc. (Bristol), A.M.I.E.E. Assistant Lecturer: G. B. Warburton, B.A.(Cantab.).

The College offers a number of exceptional advantages to students who aim at entering upon professional careers in Metallurgy or in Engineering. It is situated in the heart of an industrial area which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The manufacturers of the district, who contribute largely to the support of the College, give the staff and students of the Applied Science Departments every access to the works, and the managers, engineers, and technical officials co-operate with the staff of the College in making visits to works of practical educational value to the students. Courses of study are provided (1) for the B.Sc. Degree of the University of Wales in (a) Metallurgy; (b) Metallurgical Engineering; (c) Civil Engineering; (d) Mechanical Engineering; and (e) Electrical Engineering. Persons who are not desirous of studying for degrees or diplomas may attend selected College classes provided they satisfy the authorities of the College that they are qualified to benefit by such classes. Entrance scholarships will be offered for competition in April, 1947.

Particulars concerning admission to the College, and of the entrance scholarships, may be obtained from the undersigned.

EDWIN DREW,
Registrar.

Singleton Park, Swansea.

CIVIL SERVICE COMMISSION

Applications are invited for the following posts in the Road Research Laboratory of the Department of Scientific and Industrial Research: (a) Two posts of Deputy Director of Road Research, to take charge, under the Director of Road Research, in one case of research into problems of road safety and in the other case of research into road materials and methods of road construction. Candidates should have high scientific qualifications and proved ability in conducting scientific research and in organizing and supervising the work of research teams. Good personality and ability to work effectively with other organizations is essential. The problems of road safety will be largely physical in character and involve the use of statistical methods. Salary scale: £1,500 per annum rising by annual increments of £50 to £1,700 per annum, with superannuation provision under the Federated Superannuation System for Universities.

(b) One post of Senior Principal Scientific Officer to take charge of a group of researches into the properties of soils and their use, from the engineering aspect, in road construction. Candidates should possess high scientific qualifications, good personality and proved ability in conducting research and in leading a research team. Salary scale: £1,100 per annum rising by annual increments of £50 to £1,300 per annum, plus consolidation addition (at present £120), and with superannuation provision under the Federated Superannuation System for Universities.

Further details, together with application forms, may be obtained from the Civil Service Commission, 6 Burlington Gardens, London, W.1, quoting No. 1552, with whom completed applications must be lodged by August 1, 1946.

NEW ZEALAND

Vacancy for Chief Biochemist, Animal Research Station, Department of Agriculture. Salary up to £800 per annum (New Zealand currency), according to qualifications. Experience required, science degree in chemistry and post-graduate experience in biochemical research. The officer appointed would be expected to direct the Chemical Laboratory of the Research Station and to assist in the planning of animal experiments involving biochemical investigations.

Further particulars obtainable by August 3, 1946, from the High Commissioner for New Zealand, 415 Strand, London, W.C.2.

COMMONWEALTH OF AUSTRALIA

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

Division of Fisheries

Appointment (No. 903) of Officer-in-Charge—Section of Fisheries Exploration

Applications are invited for appointment to the position of Officer-in-Charge of a Section of Fisheries Exploration which is now being formed within the Council's Division of Fisheries, Australia. The appointee will be under the direction of the Chief of the Division but will have delegated to him the responsibility of initiating, developing and carrying out a programme of work on fisheries exploration in Australian waters and on methods of bulk catching of fish. Two experimental boats and a selection of fishing gear are already available. Arrangements for aerial observations have also been made. An applicant should possess a scientific training on the biological side and have had experience in practical fisheries work. The commencing salary will be determined within the limits of £A.1040–£A.1290 p.a. (actual) according to the qualifications and experience of the appointee. The above actual salaries include cost-of-living adjustment (at present an additional £A.40 p.a.). Note: Salary will commence from the date the successful applicant takes up duty in England, if required to do so, or one fortnight before scheduled date of departure for Australia, whichever is the earlier, and will be paid in sterling until embarkation for Australia; thereafter in Australian currency. Fares (including those of wife and family) to Australia will be paid. Subject to a satisfactory medical examination the appointee will be eligible to contribute to and receive benefits from either the Commonwealth Superannuation Fund or the Commonwealth Provident Account.

Applications, referring to appointment No. 903, and giving particulars of qualifications and experience, together with references to published work, if any, should reach the undersigned not later than August 17, 1946.

LEWIS LEWIS,
Secretary, Australian Scientific Research Liaison, Australia House, Strand, London, W.C.2, England.

THE ROWETT RESEARCH INSTITUTE, BUCKSBURN, ABERDEENSHIRE

Applications are invited for the post of Head of the Physiology Department. The salary attached to this appointment at present is £1,100 per annum plus consolidated addition of £120 per annum. The candidate should have had experience in the physiology of nutrition and will be responsible for the organisation and conduct of the research carried out in the Physiology Department. The appointment falls within the Federated Superannuation System for Universities. Practitioners serving in H.M. Forces are invited to apply.

Applications, giving the names of three referees, should be lodged on or before August 31, 1946, with the Secretary, The Rowett Research Institute, Bucksburn, Aberdeenshire, from whom further particulars may be obtained.

THE UNIVERSITY OF MANCHESTER

Department of Preventive Dentistry and Research

The University will shortly proceed to the appointment of a Biochemist to the Research Department of the Turner Dental School. The applicant should be a researcher of recognised ability in the field of Biochemistry or Experimental Physiology. He will be required to devote his time, apart from a few special lectures, to the solution of problems associated with dental disease. Previous experience in this field is not essential. The person selected will be appointed a Lecturer, Senior Lecturer or Reader in the University, and the salary will range from £750–£1,000 per annum according to the applicant's status and experience.

Applications should be sent not later than July 29, 1946, to the Registrar, The University, Manchester, 13, from whom further particulars may be obtained.

WOOLWICH POLYTECHNIC, S.E.18

The Governing Body invite applications for posts of Senior Assistants in the Departments of Physics, Telecommunications, Chemistry, Civil and Mechanical Engineering, and Electrical Engineering. Candidates should possess such high academic qualifications and industrial experience as will enable them to teach up to Honours Degree standard, and to undertake and supervise research. The salary laid down by the scales of salaries in Technical Colleges is £600–£25–£750 (plus London allowance and training allowance).

Full particulars of the appointment and application forms may be obtained from the Clerk to the Governors to whom they should be returned by August 12.

NORTHAMPTON POLYTECHNIC,

St. John Street, London, E.C.1.

Vacancies exist for Lecturers in the following departments:

Civil and Mechanical Engineering: Candidates should have good academic qualifications and industrial experience in some branch of engineering within the range of the department; applicants should include, but need not be confined to, men qualified to undertake advanced teaching in one of the following: Heat Engines; Hydraulics; Surveying and Geology; Theory of Machines and Machine Design; Automobiles.

Electrical Engineering: preference will be given to candidates who have had experience in electrical power or design.

Applied Chemistry: Candidates should be well qualified in General Chemistry and should include men with experience in Fuels or Metallurgy.

Physics: Candidates should have good academic qualifications. Experience in one of the following is desirable but not essential: Acoustics; Vacuum Technology: X-Ray Technology.

Salary in accordance with the Burnham Scale for Technical Teachers in London. Further particulars and form of application can be obtained from the Secretary at the Polytechnic.

S. C. LAWS, O.B.E., M.A., M.Sc.,
Principal.

COVENTRY LOCAL EDUCATION AUTHORITY

THE TECHNICAL COLLEGE

Principal: J. Wilson, B.Sc., B.Com., M.I.Mech.E.

CHEMISTRY AND METALLURGY DEPT.

Applications are invited for the post of Senior Assistant for Metallurgy for September, 1946. Candidates should have a good degree in Metallurgy (or equivalent qualifications) and experience in metallurgical industry or research. Teaching experience is desirable. The major part of the work involves senior and advanced Day Courses in Metallurgy. The salary will be on the scale £600 × £25–£750, less 5 per cent superannuation, subject to the approval of the Ministry of Education.

Forms of application, obtainable from the undersigned, should be returned by July 30. Applicants to a recent advertisement need not re-apply.

FRANK H. HARROD,
Director of Education

NATIONAL COLLEGE OF HOROLOGY

The Minister of Education, in consultation with the Board of Governors, proposes to appoint a Head of the National College of Horology which is being established at the Northampton Polytechnic, London, to provide for technical education and research to the highest levels in connection with the horological industry. Candidates should have good academic qualifications and industrial experience. Salary in accordance with qualifications and experience, but not less than £1,000 per annum.

Applications including particulars of age, academic qualifications and industrial experience, together with copies of three testimonials and the names of two persons to whom reference may be made, should be sent to the Secretary of the Board of Governors, National College of Horology, at the Northampton Polytechnic, St. John Street, London, E.C.1, within three weeks of the appearance of this advertisement

UNIVERSITY OF ABERDEEN

LECTURESHIP IN ORTHOPAEDIC SURGERY

The University Court will shortly proceed to the appointment of a full-time Lecturer in Orthopaedic Surgery who will also act as Orthopaedic Surgeon to the Aberdeen Town Council, Aberdeen Royal Infirmary, Royal Aberdeen Hospital for Sick Children, and the Cripples' Welfare Association. Salary £1,200 to £1,450 according to training and experience. Persons desirous of being considered for the office are requested to lodge their names with the Secretary to the University by August 10, 1946.

The conditions of appointment may be obtained from the undersigned.

H. J. BUTCHART,
The University, Aberdeen. Secretary.

BRITISH IRON AND STEEL RESEARCH ASSOCIATION

PHYSICISTS

The above Association have two vacancies for Physicists in the Scientific Officer grade, to carry out research work on instruments, electronics and automatic control. Honours University Degree essential. Salary £300/£500 p.a., according to age, qualifications and past experience. Appointments are superannuated under F.S.S.U. Written applications only to the Personnel Officer, The British Iron and Steel Research Association, 11 Park Lane, W.1, stating full curriculum vitae by August 3, 1946.

THE UNIVERSITY OF MANCHESTER

BEYER CHAIR OF ENGINEERING

Applications are invited for appointment to the above post in the Faculty of Science. Stipend: £1,300 to £1,600 per annum, according to qualifications. It is hoped that the successful candidate will enter upon his duties on September 29, 1947. Candidates should possess qualifications in Civil or Mechanical Engineering or in both.

Applications, which must be received on or before November 1, 1946, should be sent to the Registrar, the University, Manchester 13, from whom further information may be obtained.

MINISTRY OF HEALTH

SOUTH WEST REGIONAL BLOOD TRANSFUSION CENTRE, SOUTHMEAD HOSPITAL, BRISTOL

Applications are invited from scientifically qualified persons possessing a B.Sc., or Ph.D., or equivalent degree with three years' post-graduate experience in Medical Laboratory work, to take charge of the Laboratory work at the above-mentioned Transfusion Centre. Salary £540–£640 according to qualifications and experience.

Applications giving age and full particulars of experience, together with copies of not more than three testimonials, should reach the Director not later than July 27, 1946.

THE UNIVERSITY OF SHEFFIELD

Applications are invited for an Assistant Lectureship in the Department of Metallurgy. Salary £350 per annum in the first year, with superannuation provision under the Federated Superannuation Scheme for Universities and war-time marriage and children's allowances. The successful candidate will be expected to enter upon his duties by October 1, 1946.

Applications (3 copies) including the names and addresses of three referees and, if possible, copies of two testimonials should reach the undersigned (from whom further particulars may be obtained) by August 31, 1946.

A. W. CHAPMAN,
Registrar.

WOOLWICH POLYTECHNIC, S.E.18

The Governing Body invite applications from Honours Graduates for the following Lectureships: (i) Physics. (ii) Telecommunications. (iii) Chemistry. (iv) Electrical Engineering. (v) Mathematics. (vi) Civil and Mechanical Engineering. Candidates will be required to teach to Honours Degree standard in the particular subject. Salary in accordance with the scales of salaries in Technical Colleges.

Full particulars for the posts and application forms may be obtained from the Clerk to the Governors to whom they should be returned by August 12.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM

The Council of the Association invite applications for the post of Marine Zoologist at the Plymouth Laboratory. Applicants should have honours degrees and preferably some research experience. The commencing inclusive salary for men will be between £333 and £560 per annum according to qualifications, with annual increments of £25. The post entails membership of the Federated Superannuation System for Universities.

Forms of application may be obtained from the Secretary of the Marine Biological Association, The Laboratory, Citadel Hill, Plymouth, and should be returned to him not later than August 31, 1946.

UNIVERSITY OF ABERDEEN

LECTURESHIP IN GEOGRAPHY

The University Court will shortly proceed to the appointment of a Lecturer in Geography with special qualifications in physical geography. Salary £500–£600 according to experience. Persons desirous of being considered for the office are requested to lodge their names with the Secretary to the University by August 24, 1946.

The conditions of appointment and form of application may be obtained from the undersigned.

H. J. BUTCHART,
The University, Aberdeen. Secretary.

H.M. DOCKYARD SCHOOLS

ASSISTANT MASTERS

Applications are invited for Appointments as Assistant Masters in the above Schools for service beginning on August 26, 1946, or as soon after as possible. Candidates should possess an Honours Degree in Mathematics, Physics or Engineering, or have equivalent qualifications.

Further particulars can be obtained from the Director, Education Department, Admiralty, London, S.W.1, to whom all applications should be addressed as soon as possible.

CITY OF CARDIFF EDUCATION COMMITTEE

THE TECHNICAL COLLEGE

Principal: A. Harvey, Ph.D., B.Sc., F.Inst.P.

Applications are invited for a full-time Lecturer in Pharmaceutical Chemistry. A degree in pharmacy is essential and an honours degree in chemistry, or the A.R.I.C., desirable. Salary will be in accordance with the Burnham Technical Scale.

Forms of application, etc., are obtainable from the undersigned, on receipt of a stamped addressed foolscap envelope, and should be returned as promptly as possible.

W. J. WILLIAMS,
City Hall, Cardiff. Director of Education

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

LECTURER IN PHYSICS

Applications are invited for a lectureship in Physics, salary scale £500 rising to £700 by annual increments of £25 with membership of the F.S.S.U. A special report will be required from the Head of the Department concerned before a Lecturer's salary is increased beyond £600. The initial figure at which the salary will commence will depend on the experience and qualifications of the successful candidate.

Applications to the Head of the Physics Department, Imperial College of Science and Technology, London, S.W.7.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF MATHEMATICS

Applications are invited for vacancies in the grades of Assistant Lecturer and Demonstrator. Further details may be obtained from the Head of the Department of Mathematics, Imperial College, Prince Consort Road, London, S.W.7, to whom applications should be submitted as soon as possible.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

LECTURER IN INVERTEBRATE ZOOLOGY

Applications are invited for a Lectureship in Invertebrate Zoology, salary scale £500–25–£600–25–£700, with F.S.S.U. membership. The appointment will be, in the first instance, from September 1, 1946.

Further details may be obtained from the Head of the Zoology Department, Imperial College, Prince Consort Road, London, S.W.7, to whom applications should be sent before August 9, 1946.

BEDFORDSHIRE EDUCATION COMMITTEE

Luton High School. Wanted in September, highly qualified and experienced Specialist to take charge of the chemistry and physics department and to teach these subjects up to and including Higher School Certificate and Scholarship work. Post of special responsibility. Salary Burnham Provincial scale. Apply immediately to the Head Mistress with full particulars.

THE UNIVERSITY OF LEEDS

Applications are invited for the post of Demonstrator in Botany at a salary of £300; the appointment will be for one year in the first instance but will be renewable up to three years. Further particulars may be obtained on request. Applications should reach the Registrar, The University, Leeds, 2, not later than August 10, 1946.

UNIVERSITY COLLEGE, EXETER

Male Assistant wanted for visual education. Should hold science degree and have had experience in school teaching and knowledge of optical equipment. Particulars from the Registrar.

University of Durham.—Applications

are invited for the Readership in Pharmacology and Experimental Physiology, in the Department of Physiology in the Medical School, King's College, Newcastle upon Tyne. Salary £950 per annum with superannuation (F.S.S.U.). Appointment from October 1, 1946, or as soon thereafter as possible.

Applications (12 copies) giving the names of not more than three persons to whom reference may be made, should be lodged not later than September 7, 1946, with the undersigned, from whom further particulars may be obtained.

W. S. ANGUS,
University Office, Registrar.
23 St. Thomas' Street, Newcastle upon Tyne, 1.

Required by Polish Board of Technical

Studies part-time lecturers and demonstrators to teach in English up to matric and inter standards in Physics, Mathematics, English (General and Science). Applications in writing to P.B. of T.S., 5 Princes Gardens, London, S.W.7, giving full particulars.

(*Continued on page* iv *of Supplement*.)

(*Continued from page* iii *of Supplement.*)

Courtaulds, Ltd.—Applications are invited for the following positions in the Dyeing, Printing and Finishing Section of the Textile Research and Development Department: (1) A Graduate Chemist, capable of carrying out research and development on textile-chemical processes, preferably with experience in the textile industry (ref. G1). (2) A Textile Technologist with experience in the Dyeing and Finishing Industry and a sound knowledge of chemistry (Ref. G2). (3) A Textile Technicist with experience in the Textile Printing Industry, preferably screen printing, and a sound knowledge of chemistry (Ref. G3). Applicants for the above three positions should be under 40 years of age and interested in experimental and development work. (4) A Graduate Chemist with experience in colloids and preferably some knowledge of, and interest in, textile problems (Ref. G4). (5) A Graduate Physicist with a knowledge of, and interest in, textile problems (Ref. G5).

Persons interested in any of the above positions should write quoting the appropriate reference number, for a questionnaire, to the Director of Personnel, Courtaulds Limited, 16, St. Martin's-le-Grand, London, E.C.1.

The Research Organization of a large industry overseas (concerned with the utilization of diamond for industrial purposes) invites applications for the following active research appointments: (1) Mechanical Engineer with research experience on properties of materials and fine precision design work. (2) Physical Chemist with experience of plastics manipulation, surface chemistry, spectrophotometry, etc. (3) Physicist with X-ray crystallography experience. (4) Metallurgist with experience of powder metallurgy, hard metals, steel and non-ferrous alloys. (5) Theoretical Physicist with special bias to modern theories of crystal and atomic structure, and general interest in physico-chemical and engineering problems.

In any of the appointments, experience of industrial applications of abrasives would be an asset. A high standard of theoretical and practical approach to the work entailed is required. The appointments are overseas in a good climate: model conditions of employment will be offered, and secured to selected candidates on proof of aptitude. Box 639, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Chief Research Chemist. A Research Institute in Cheshire requires a leader of a team of Research Chemists. Applicants must possess high academic qualifications, experience in Chemotherapy, and initiative. The Institute also comprises a pharmacology laboratory, with the head of which the successful applicant will be expected to collaborate. The salary will depend on qualifications, experience and personality. Applications giving full details should be addressed to Box 640, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Laboratory assistants of at least Matriculation or Intermediate B.Sc. standard required by large company in the following centres: Bristol, Cardiff, Glasgow, Hendon, Leeds, Liverpool and London, for work in connection with beverage manufacture. Training and good salary will be provided for the selected persons with facilities for further study. The situations have good prospects with pension scheme. Please reply, stating age, qualifications, salary required and experience, if any, to Box No. 8450, The Winter Thomas Co., Ltd., 31, Gt. Queen Street, London, W.C.2.

A Chemical Laboratory Assistant is required by a well-known firm of chemical and electrical instrument makers. Applicants should have a basic knowledge of chemistry and physics and some skill at simple glass-blowing. A salary of £5 to £7 per week will be paid according to qualifications. This position offers permanent employment in the North London area. Box 644, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

The Patent Department of the Research Laboratories of the General Electric Co., Ltd., East Lane, North Wembley, require Assistants for general patent work. Applicants should apply in writing and should possess a good honours degree in general science, physics or engineering. A knowledge of patent work would be an advantage but is not essential.

There is a vacancy at Rothamsted Experimental Station, Harpenden, Herts, for a research Entomologist to study the field behaviour of wireworms in relation to baits and repellants. Consolidated salary up to £450 according to qualifications. The position is not on the permanent staff. Further particulars can be obtained from the Secretary, to whom application should be made.

Food Research—First-class Honours graduates in physical or organic chemistry and men about to graduate this summer are invited to apply for appointments in a London research laboratory shortly to be established. The work will embrace both fundamental and applied aspects of food systems. It will be backed by adequate financial resources of an established group of food companies. Minimum salary will be £500 p.a., with admission to a generous pension scheme. Box 645, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Well-known Company in the West Country has a vacancy in their technical library for a Senior Assistant, having qualifications to degree standard in chemistry and physics, a knowledge of technically important languages, and experience in abstracting and indexing. Good prospects. Apply stating age, experience, salary required, and availability to Box 642, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

University of London.—The Senate invite applications for the University Chair of Medicine tenable at the British Postgraduate Medical School (initial salary £2,500). Applications must be received not later than first post on September 3, 1946, by the Academic Registrar, University of London, Senate House, W.C.1, from whom further particulars should be obtained.

Assistant Chemist required in food factory in South London. Man or woman of at least Inter. B.Sc. standard, preferably with knowledge of bacteriology. Salary according to qualifications and experience. Apply with full particulars of experience to Box 8454, The Winter Thomas Co., Ltd., 31 Gt. Queen Street, London, W.C.2.

Secretary for technical director of Chemical Company. Lady required with good shorthand-typing and able to work on own initiative. Good salary and prospects. Shortly removing to Stepney area. Apply Box 641, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Physicist, previous experience in geophysical prospecting an advantage, though not essential, required by firm of consultants. Apply, stating age, qualifications, experience and salary required. Box 643, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

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of policy, and its results applied in improving the standard of life both of the people in Great Britain and of the whole Commonwealth.

Science and Anglo-American Relations

THE Messel Memorial Lecture of the Society of Chemical Industry was delivered on July 12 by Dr. W. P. Cohoe, president of the Society during 1943–44, and previously chairman in turn of the Canadian and the American Sections of the Society. Dr. Cohoe took as his subject "Science and Anglo-American Relations". Referring to the co-operation which existed during the War, he said that if Great Britain, Canada and the United States could work together for purposes of destruction, it should equally be possible for them to work together in the cause of world peace. The physical domination which they possess involves the responsibility for moral leadership, and Dr. Cohoe pointed out that we have yet to learn the lesson that in scientific findings there resides a centre or nucleus of preparedness which may be used for the preparation of peace. The scientific leadership and pre-eminence possessed by the English-speaking nations at the present time centre around the release and control of nuclear energy, but without belittling such achievements, Dr. Cohoe insisted that we should not overlook the scientific work which has been done for the preservation of the health of the human race. Furthermore, the benefits mankind has derived from scientific advance depend upon common understanding and co-operation between workers in pure science, in technology and in production.

Dr. Cohoe rests his hopes of permanent co-operation between the members of the Anglo-American family on three factors: friendly intercourse; a recognition of the value and use of the religious motive in human affairs; and a common interest in the affairs of everyday life. The use of the scientific method in matters of religion, he believes, will establish freedom from fear of the unknown, from superstition, from orgiastic emotion characteristic of paganism, and from the inhibitions of man-made dogma. Science, he thinks, will be a major factor in the establishment of an everyday common interest in business. But we must face three other problems in international business relations to which he referred briefly in conclusion: the gradual domination of the technological mind over the accounting habit and attitude, a trend which enhances the importance of the technologist being able to expound his ideas and plans clearly; the problem presented by the value of intellectual property, such as patents; and the probability that America, as a consequence of the exigencies of war finance, will become a capital-exporting country and will seek investment in the United Kingdom.

Prehistoric Archæology at the University of Edinburgh: Mr. Stuart Piggott

MR. STUART PIGGOTT, who has been appointed to the chair of prehistoric archæology in the University of Edinburgh in succession to Prof. V. Gordon Childe (see *Nature*, March 9, p. 293), is still appreciably under forty and is a notable instance of a man rising to academic eminence without having graduated at a university at the ordinary time of life. He is a native of Petersfield, Hants, where he studied the local archæology keenly in boyhood; he then began his career as a museum assistant at the Reading Museum, where his work both in the museum and as a field student of the antiquities of the Berkshire Downs attracted the attention of archæologists; and he was appointed to the staff of the Royal Commission on Ancient Monuments in Wales. He specialized in the Neolithic archæology of Britain, and in 1932 published what became the standard monograph on British pottery, in collaboration with Prof. Gordon Childe. He next went to the Morven Institute of Archæological Research operated by Mr. Alexander Keiller, with its headquarters at Avebury; in addition to valuable work with Mr. Keiller, he also published further researches of his own, notably on the Early Bronze Age of Wessex and its relations with Brittany and Europe generally and with Mycenean Greece, for he had by this time travelled in France, Greece and Scandinavia. After his marriage shortly before the War, he and his wife settled at Rockbourne near Salisbury and undertook excavations and surveys of the prehistoric antiquities of Cranborne Chase and other districts.

When war broke out, Piggott at once joined the Royal Artillery; when he obtained his commission he was seconded for duty with the R.A.F. Central Interpretation Unit at Medmenham, as experience in interpreting archæological air photographs qualified him especially for this work. So successful was he that in 1942 he was transferred to India, where a similar interpretation unit was built up for the service of S.E.A.C. He remained in India until nearly the end of the War; and found time in intervals of duty to make an intensive study of the prehistoric archæology of Northern and Central India and the districts of Baluchistan between the Indus valley and the Iran–Iraq areas of ancient civilization. Mr. Piggott is an excellent black and white draughtsman, and illustrates all his own work. He will take to Scotland a wide grasp of prehistoric archæology in general and its place in the realm of humane and of scientific studies, as well as a keen eye for the problems of local field-work and excavation.

Civil Engineering at King's College, London: Prof. C. H. Lobban

PROF. C. H. LOBBAN, who is retiring, during the present summer, from the chair of civil engineering at King's College, London, took his degree at the University of Glasgow and had practical experience in the Glasgow area; he served as demonstrator for two years at that University, going on from there to a lectureship at the University of Manchester, and later to a professorship at Madras. For four years before the First World War he was in practice in Scotland as a civil engineer, and during the War served in France with the Royal Engineers. After serving as assistant controller of the Disposals Board, he joined King's College, London, in 1920. There he is remembered by many generations of engineering students as a keen and efficient engineering teacher, and, in particular, for the elegant solutions that he developed for problems in the field of structural theory. His research work into structural analysis by the deformeter is widely recognized and he was awarded the D.Sc. of Glasgow in 1925 for a thesis on "Grillage and Reinforced Concrete Foundations". He has also carried out important consultative work. He was responsible for the structural design of various buildings, including Victoria House, Southampton Row, London, W.C.1, the London School of Hygiene and Tropical Medicine, and University College, Nottingham. He served as the first technical

officer of the Steel Structures Research Committee of the Department of Scientific and Industrial Research.

Mr. J. S. L. Gilmour

Mr. J. S. L. Gilmour, who has just been appointed director of the Royal Horticultural Society's gardens at Wisley, has been assistant director at the Royal Botanic Gardens, Kew, since 1931, although during the War he was seconded to the Ministry of Fuel and Power. While at Kew he showed himself to be an able administrator, and his genuine and assiduous interest in the welfare of the student-gardeners will engender a feeling of personal loss beyond the circle of his immediate colleagues. It is a happy augury for the future of horticulture that the directorships of the Royal Gardens, Kew, and the gardens at Wisley should be thus held by men linked by ties of friendship and common interests. Changing economic conditions must inevitably bring about considerable re-orientation of the pursuits and interests of the fellows of the Royal Horticultural Society and thus influence the purpose and policy of their Gardens, so that our good wishes go out to Mr. Gilmour in his difficult but interesting task.

National Union of Teachers: New General Secretary

Mr. Ronald Gould has been appointed general secretary of the National Union of Teachers in succession to Sir Frederick Mander, who is to retire in 1947. Mr. Gould was president of the Union during 1943–44. He is at present headmaster of Welton Council School, Bath, and is a well-known figure in the teaching world. He was educated at Shepton Mallet Grammar School and received his professional training at Westminster College. After leaving college, he was appointed assistant master at Radstock Council School, and while in this area became president of the Radstock Association of the National Union of Teachers, a representative on the County Teachers' Association and Somerset's representative on the Lower Paid Areas' Association Council. He was elected as an executive member of the National Union of Teachers in 1937. He has been a member of the Burnham Committee on Teachers' Salaries since 1938.

Society for the Protection of Science and Learning

In 1933, when the rise of the Nazi party rendered the position of men of science and other scholars extremely dangerous, the Academic Assistance Council was founded to help the refugees; later its title was changed to the Society for the Protection of Science and Learning. The recently published fifth annual report (issued from Westminster College, Cambridge) surveys the Society's activities for the years 1939–45. These years, being war years, have necessitated the limitation of the survey chiefly to an account of the academic refugees in Great Britain. Of the 2,541 individuals who were registered, only 601 are now in this country. The majority of those who have found employment abroad are in the United States. Some of these are in the special foundations of French and Polish exiled scholars, or on the staff of the School for Social Research in New York. Spanish exiles have found their way to Mexico, and the Central and South American countries have absorbed a large number of the refugees. Others have gone to the British Dominions, some to Turkey, Palestine, Sweden and Switzerland. Of those in Great Britain, about 40 per cent are in universities and parallel institutions. Another group, about 36 per cent, are employed in some of the professions, industry and the Government service. Scholars of Allied nationality have returned or will return to their own countries if they are Dutch, Belgian, French or Scandinavian, but the Poles and some of the Czechs are in a difficult position. So far as numbers are concerned, the Germans and Austrians present special problems. Some with a good war record have been naturalized; these will presumably remain in Britain, but some definitely wish to return, and discussions are now taking place for the return of some of them to the British zone. The report emphasizes that the Society is not a welfare agency in the usual sense, but exists to make the work of refugee scientific workers and other scholars available, by maintaining them while other support is not forthcoming. It is expected that in a few years time the activities of the Society will be considerably curtailed, but in the meantime much work still remains to be done.

Fifty Years of Danish Marine Biology

The interruption to research caused by the War has been utilized by Dr. Blegvad to produce a lavishly illustrated account, full of interesting personal details, of the first fifty years work of the Danish Biological Station (*Report Danish Biol. Stat.*, 45; 1940, published 1944). In 1899 a moored transport vessel was adapted for use as a laboratory under the direction of C. J. Johannes Petersen. A long series of papers published during thirty years shows how much marine biology owes to his energy, ability and originality. Early famous for his invention, still in use, of a method of marking living fish, his bottom-sampling grab led to a greatly extended knowledge of animal life of the sea-bottom and of the food available for marketable fish such as plaice. The laboratory has always been closely connected with the University of Copenhagen, while under the late A. C. Johansen and the present director there has developed a friendly and valuable collaboration with the fishermen, who have benefited financially from the experiments on transplantation of young plaice from the North Sea to richer feeding-grounds. Housed now in the beautiful Charlottenlund Castle, with a fine modern aquarium close by and a well-equipped research vessel and motor-boat available, the Station is well qualified to play again an active part in solving regional and international problems of aquatic biology.

Nuclear Energy and its Utilization

An address delivered at Cordoba Observatory, Argentina, by E. Gaviole, president of the Argentine Physical Association, points out that men of science are generally agreed that within five years every major industrial country that wishes will possess atomic bombs, that there is no defence against surprise atomic aggression and in any such warfare both combatants will suffer unparalleled destruction in a few days. Accordingly, the object should be to avoid war; and nations should surrender a part of their sovereignty to achieve security. Commenting that the scientific workers of the southern hemisphere are in a privileged position and unlikely to be a target, Dr. Gaviole suggests that the fact that governments themselves will be exposed to attack

may be a factor in avoiding war, but points out that disarmament, by putting a premium on the power that breaks agreements and arms secretly, is dangerous. He questions the practicability of international organisation in the shape of a police force, partly on the grounds of loyalties, and suggests that any international organisation of scientific workers would be rendered futile by these factors of secrecy and national loyalties. While Dr. Gaviola displays the difficulties of the situation, he appears to lose sight altogether of the favourable factors emphasized by the American report on the international control of atomic energy, and a rather depressing and complacent address demonstrates the need of the moral imperative stressed in the report from the Commission appointed by the British Council of Churches.

Training of Demobilized Electrical Engineers

Among the various questions considered at a recent meeting of the Electrical Engineering Committee of the Technical and Scientific Register were proposals for securing employment for men who joined the technical branches of the Forces immediately on graduation and are now being demobilized. They have not previously had industrial experience, but many have had the advantage of commissioned service in technical corps and have shown qualities of leadership and initiative which should be of great value to industry. Suggestions made by the Committee are likely to lead to experimental schemes of training in industrial concerns with the view of preparing these ex-Service personnel for responsible posts after training. The Committee realizes that adequate pay arrangements will be required in order to make training schemes of this kind economically practicable. The Committee stressed the importance of developing still further the close co-operation which already exists between the Ministry of Labour's Technical and Scientific Register and the Professional Engineers Appointments Bureau, and expressed the hope that industry generally would make use to the fullest possible extent of the facilities offered by the Register. The Committee also considered a detailed report of the work of the Electrical Engineering Section of the Register.

Luccock Medical Research Fellowships

The Luccock Fellowships have been established by King's College, University of Durham, as a result of the bequest of the late Mr. J. W. Luccock, who left his money "to enable research to be made and carried on as to the component parts of the blood of human beings with the view and in the hope that such research investigation and enquiry will be of benefit to the human race and increase the knowledge of the medical and surgical profession as to all matters relating to the blood which may result in the alleviation of human suffering and probably the prolongation of life". Fellows elected will be required to pursue full-time research in the University of Durham in an approved subject in the field of medicine (including dental surgery). Senior fellowships are of the minimum annual value of £600 and are open to any person who by publication or otherwise has proved himself able to carry out original research in the field of medicine (including dental surgery) and are tenable for three years. Junior fellowships are of the minimum annual value of £300 and are open to any person holding medical, dental or scientific qualifications, and are tenable for one year. Supplementary grants in aid of the expenses of the research may be sanctioned by the Council of the College, and any apparatus purchased by these means will remain the property of the College.

Spitfire Mitchell Memorial Scholarships

As a memorial to the work of Mr. R. J. Mitchell, designer of the Spitfire, two Spitfire Mitchell Scholarships have been founded to train students in aircraft design and engineering. These Scholarships will be of the value of £60 a year for three years and will be tenable at University College, Southampton. Applications should be made to the Registrar, University College, Southampton, not later than August 12, and should be accompanied by a statement of the candidate's education and experience, and a recommendation from his employer or headmaster, together with the candidate's own age, which must be more than seventeen. The awards are in the hands of the Royal Aeronautical Society, the Society of British Aircraft Constructors, Messrs. Vickers-Armstrongs, Ltd., and the Committee of the Spitfire Mitchell Memorial Fund.

Announcements

Prof. Lise Meitner will deliver a public lecture on "Atomic Energy" at Chatham House, St. James's Square, S.W.1, on July 30 at 8 p.m. Admission is free by ticket obtainable from the British Federation of University Women Ltd., 17A Kings Road, London, S.W.3.

Mr. Horace Cole has been appointed lecturer in the chemistry of glass in the University of Sheffield. The following resignations have been announced: Dr. Andrew Wilson, lecturer in pharmacology and therapeutics; Dr. J. Dick, lecturer in mechanical engineering; Dr. J. H. Hale, assistant bacteriologist and demonstrator.

Mr. Cyril Bibby, at present education officer to the Central Council for Health Education, is resigning that post on his appointment as senior lecturer at the College of St. Mark and St. John, Chelsea, London.

As one method of meeting the demand for chemical engineers which modern industrial development is creating and increasing, the Ministry of Education is arranging for full-time intensive training courses in a number of technical colleges (see *Nature*, July 6, p. 20). The courses will last for approximately twelve months, and will be recognized by and operated in co-operation with the Institution of Chemical Engineers. Applications for further information (Leaflet P.L. 216) should be addressed to the Ministry of Labour and National Service, Technical and Scientific Register, York House, Kingsway, London, W.C.2.

In furtherance of its policy of promoting the study of textile technology, the Textile Institute is now offering two scholarships for students, each of three years tenure and of total value £750. The scholarships are offered under the terms of a grant from the Cotton Trade War Memorial Fund, and young craftsmen engaged in the cotton spinning or weaving industry are eligible. Forms of application, conditions and other information are available from the General Secretary, Textile Institute, 16 St. Mary's Parsonage, Manchester 3. Applications must be made by August 3.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Medical and Other Patents for the Use of Mankind

BEFORE the War my laboratory was supported by the Josiah Macy Jr. Foundation, New York, receiving 3,000 dollars a year. This help enabled me to work without limitation and publish without restriction. During the War, this help ceased and forced me to seek the help of industry. I worked out a method for the preparation of a substance of high biological importance and therapeutic value, a substance which has found no application yet for lack of a suitable method of preparation. As a recompense for the help obtained, I had to offer this method to industry and keep it secret. The result is that for the sake of 10,000 dollars a substance is inaccessible which could relieve much human suffering. In the present financial conditions of my country, the State is unable to give necessary support for research; and I, having greatly extended my laboratory, am compelled to seek further collaboration with industry. Possibly my work will lead shortly to the discovery of new, highly important substances, and I shall be unable to talk about them freely. The other laboratories and research workers of my country are in a similar condition and the free, generous, international spirit of science is endangered. Maybe my country, being small and poor, does not matter much; but such trends spread easily and should be suppressed at their roots.

I wish to submit this problem to readers of *Nature*. I wonder whether the United Nations Educational, Scientific and Cultural Organisation could do something in this matter, perhaps suggesting to chemical industries the creation of an international fund for the support of research and for purchasing patents for the common use of mankind or, at least, for the use of the contributors, enabling at the same time researchers to work and publish freely. I expect most research workers would prefer to offer their work and results to such a body, which may even solve the old problem of how scientific men can be protected from exploitation and enjoy the fruits of their own work without disadvantage to the human community.

A. SZENT-GYÖRGYI

Biochemical Institute,
University,
Budapest.
April 7.

Reactions of Organic Halides in Solution

DR. A. G. EVANS has recently discussed those bimolecular and unimolecular substitutions in which a nucleophilic reagent displaces halogen as halide ion from an alkyl halide[1].

With reference to the bimolecular reactions ($S_{N}2$), he ascribes to us the view that the diminution of rate along the series Me, Et, *i*-Pr, *t*-Bu is entirely due to the polar effect of the alkyl group. This is a mistaken presentation of our ideas. For, in the first place, we regard the polar and steric effects as both contributing to the structural influence on rate: we stated this qualitatively in 1935[2], and have more recently indicated means of assessing quantitatively the separate effects[3]; furthermore, in 1937[4] we emphasized the special importance of steric hindrance (which has its physical basis in the exclusion principle) in relation to the spatial orientation of bimolecular substitution, contrary to an earlier idea[5] that polarity was determinative in this connexion. The second important point is that, as we have repeatedly insisted, the polar effect in bimolecular reactions is itself ambiguous[6]: it includes a polarizability effect, and therefore depends (for substitutions) not only on the compound substituted, but also on the substituting agent and the solvent. For example, in substitutions of alkyl halides in polar solvents by simple anionic reagents, such as halide or alkoxide ions, the polar effect may be expected to lead to rate differences in the direction illustrated; but this inference from simple electrostatic considerations does not embrace corresponding substitutions by such neutral reagents as pyridine. Our picture of the situation has been explained at length in our papers, and is not susceptible of the type of simplification with which Evans has tried to represent it.

Evans himself takes the extreme view that the polar effect envisaged by us is completely absent from the bimolecular substitutions, though steric hindrance remains important[7]. That the polar effect is not absent in general from bimolecular nucleophilic substitutions is consistent with the result of exchanging the electron-releasing methyl substituents for electron-attracting groups: here, in the case of substitution by anionic reagents, we find that the effect of the substituent, in spite of steric hindrance, is often accelerative. We pointed this out in 1935, using the illustrations then available: several new examples have since been recorded. For an assessment of the relative importance of polar and steric effects in cases in which both reduce reaction-rate, we again refer to our general discussion[3]. We agree that steric hindrance is present in the bimolecular substitutions of α-methylallyl halides: Catchpole had pointed this out[8], and the case is included by implication in our general consideration of steric hindrance by alkyl groups. The conclusion does not, however, follow logically from Evans's argument, which, by carrying over a rate comparison of two compounds from one reaction mechanism to another, ignores the duplex nature of polarity and the dependence of polarizability effects on mechanism[6].

Turning to the unimolecular substitutions ($S_{N}1$), the rates of which are controlled by the rates of ionization of the alkyl halides, Evans concludes that the increase of rate along the alkyl series Me, Et, *i*-Pr, *t*-Bu is 'due to' the decrease of ionization potential of the alkyl radical. We agree that the two phenomena are related, but would prefer to express the relationship by saying that the increase of ionization-rate and the decrease of ionization potential (in other words, the ease with which an alkyl cation separates, on one hand, from an anion, and on the other, from an electron) are analogous manifestations of the same structural causes.

E. D. HUGHES
C. K. INGOLD

Sir William Ramsay and Ralph Forster Laboratories,
University College, London.
June 14.

[1] Evans, A. G., *Nature*, **157**, 438 (1946).
[2] Hughes and Ingold, *J. Chem. Soc.*, 244 (1935).
[3] Hughes, *Trans. Farad. Soc.*, **37**, 603 (1941). Dostrovsky and Hughes, *J. Chem. Soc.*, 157 *et seq.* (1946). Dostrovsky, Hughes and Ingold, *J. Chem. Soc.*, 173 (1946).
[4] Cowdrey, Hughes, Ingold, Masterman and Scott, *J. Chem. Soc.*, 1256 (1937).
[5] Meer and Polanyi, *Z. phys. Chem.*, B, **19**, 164 (1932).
[6] Ingold, *Chem. Rev.*, **15**, 225 (1934). Hughes, Ingold and Shapiro, *J. Chem. Soc.*, 225 (1936). Bateman, Cooper, Hughes and Ingold, *J. Chem. Soc.*, 925 (1940). Hughes, Ingold and Taher, *J. Chem. Soc.*, 949 (1940).
[7] Evans, A. G., and Polanyi, *Nature*, **149**, 608, 665 (1942).
[8] Catchpole, A. G., Thesis, London (1942).

Friedel–Crafts Catalysts and Polymerization

IN an earlier communication[1], evidence was given upon which the following conclusion was based. In the dimerization of di-isobutene and the polymerization of isobutene, it is essential that a trace of some third component, X, shall be present in addition to the monomer and the Friedel–Crafts catalyst, in order that the reaction shall proceed at an appreciable rate. It was suggested then that this third component was probably water. We have continued this line of investigation by studying the boron trifluoride-catalysed polymerization of isobutene in the gas phase using high-vacuum technique. The polymerization reaction was followed by mixing the boron trifluoride and the isobutene in the gas phase and measuring the fall in pressure with time. We may summarize the results as follows:

(*a*) The unpurified isobutene, taken straight from the cylinder, reacts rapidly when its pressure is greater than a certain value (Curve *A*).

(*b*) Isobutene, purified by many distillations from − 80° C. to liquid air *in vacuo*, reacts very slowly under conditions which are otherwise identical with those for the experiments described in (*a*) (Curve *B*).

(*c*) The purified isobutene reacts rapidly if mixed with vapour of the residue from the distillation described in (*b*) (Curve *C*).

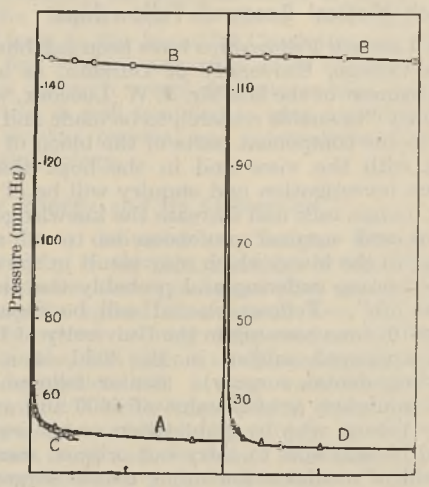
(*d*) This residue was identified as water by measurements of vapour pressure and freezing point.

(*e*) Purified isobutene reacts rapidly if previously mixed with water vapour. So little as 10^{-1} mm. of water vapour is sufficient to give the rapid reaction (Curve *D*).

(*f*) When water is present with the isobutene in the gas phase, part of the boron trifluoride which is introduced into the mixture is removed by combination with the water. The boron trifluoride and water combine in practically equal molar quantities.

(*g*) When water had been added to purified isobutene to cause the rapid reaction in one experiment, the addition of boron trifluoride to the purified isobutene alone in the subsequent experiment was sometimes found to lead to rapid reaction. If the reaction vessel was pumped out for about half an hour between the two experiments, however, the purified isobutene used alone in the second experiment did not give the rapid reaction on addition of boron trifluoride.

We conclude from these experiments that for isobutene to be rapidly polymerized in the gas phase, the presence of both BF_3X and excess boron trifluoride are necessary. In the experiments described in this communication, the third component, X, is water.



A, UNPURIFIED ISOBUTENE; *B*, DISTILLED ISOBUTENE; *C*, DISTILLED ISOBUTENE PLUS 1% RESIDUE VAPOUR; *D*, DISTILLED ISOBUTENE PLUS 0·1% WATER VAPOUR

Note added in proof. If a mixture of purified isobutene and boron trifluoride, undergoing the very slow reaction in the gas phase at room temperature, is condensed in liquid air, it is found on warming up that all the isobutene has polymerized.

A. G. Evans
G. W. Meadows
M. Polanyi

Chemistry Department,
University,
Manchester.
June 19.

[1] Evans, A. G., Holden, Plesch, Polanyi, Skinner and Weinberger, *Nature*, **157**, 102 (1946).

Composition of Cupric Ammino Nitrates

In a recent publication[1] from this laboratory, we have described our results on the study of the composition of cupric ammino sulphates by the new electrical conductivity method[2] of Dey and Bhattacharya. In other communications we have described the isolation of cupric pentammino sulphate by alcoholic precipitation from ammoniacal solutions of cupric sulphate.

The new electrical conductivity method has now been applied to the study of the compositions of the cupric ammino nitrates and I shall here briefly report the results obtained. The method consists in the determination of electrical conductivities of a solution of cupric nitrate, of solutions of ammonium hydroxide of various concentrations and also of mixtures of cupric nitrate with different concentrations of ammonia. The conductivity of the mixture was observed to be higher than that of either constituent, and even greater than the sum of the conductivities of the constituents of the mixture. A graph was plotted with composition as the abscissæ and the percentage increase in conductivity as the ordinates. The curve gave several breaks corresponding to 3, 4, 5 and 6 molecules of NH_3 for a molecule of $Cu(NO_3)_2$, thus leading to the inference of the existence of tri-, tetra-, penta- and hex-ammino compounds of cupric nitrate.

The light absorption of mixtures of cupric nitrate with varying concentrations of ammonia were studied by a Nutting's spectrophotometer, and we obtained shifts in the regions of maximum absorption corresponding to mixtures of the compositions $Cu(NO_3)_2.4NH_3$, $Cu(NO_3)_2.5NH_3$ and $Cu(NO_3)_2.6NH_3$. We could not study the mixture with lower dilutions of ammonia as the solution becomes opaque due to hydrolysis.

Thus these results confirm the existence of the well-known tetra- and penta-ammino compounds of cupric nitrate. Horn[4] isolated a compound $4Cu(NO_3)_2.23NH_3$, which has been called the hexammino compound by some workers. It seems that Horn obtained the hexammino compound, but probably due to its unstability he could not determine the correct composition. My results also favour the existence of the hexammino compound. Further, the existence of the new triammino compound is undoubted, as shown by my electrical conductivity experiments.

I am indebted to Dr. A. K. Bhattacharya for his kind interest in this investigation.

Arun K. Dey

Department of Chemistry,
University of Allahabad.
May 20.

[1] Dey and Bhattacharya, *Curr. Sci.*, **14**, 69 (1945).
[2] Cf. Dey, *Curr. Sci.*, **15**, 24 (1946).
[3] Dey and Bhattacharya, *Curr. Sci.*, **14**, 201 (1945); *Proc. Ind. Acad. Sci.*, **23** A, in the press.
[4] Horn, *Amer. Chem. J.*, **37**, 620 (1907); **39**, 216 (1908).

Thorium Borate Sol and Gel

Berzelius[1] reported that boric acid precipitates white flocculent thorium borate when added to a solution of a salt of that element; the precipitate is insoluble in an excess of boric acid. Karl[2] discussed the composition of the amorphous white precipitate obtained by treating an aqueous solution of thorium nitrate with a hot solution of borax and showed that the composition corresponded with thorium orthoborate, $Th_3(BO_3)_4$. Guertler[3] could not prepare thorium borate by fusing thoria with boric oxide on account of the very sparing solubility of the thoria. A search of the literature revealed that no work is on record on the formation of the hydrosol and the hydrogel of thorium borate. An attempt has now been successfully made in this laboratory to prepare thorium borate hydrosol and hydrogel.

When a hot concentrated solution of borax is gradually added to thorium nitrate solution, a white precipitate of thorium borate is obtained which dissolves on vigorous shaking in presence of excess of thorium nitrate. In this way a considerable amount of thorium borate can be made to disperse in thorium nitrate. If this mixture be now kept in a parchment bag and dialysed until free from electrolytes, a clear colourless sol of thorium borate is obtained. The sol can be shown by electrophoresis to be positively charged.

A sol was prepared by allowing a hot 20 per cent solution of borax to run slowly into 75 c.c. of 10 per cent thorium nitrate solution until the precipitate of thorium borate scarcely dissolved in thorium nitrate on vigorous shaking. The mixture was dialysed at room temperature (30° C.) for eight days. The analysis of the coagulum of the sol obtained by the cataphoretic method indicated that the empirical formula of the sol was $4ThO_2.Th_3(BO_3)_4$.

The sol could be easily coagulated with electrolytes: and when *N* potassium chloride and *N*/5 potassium sulphate were used as coagulators, the sol formed beautiful transparent jellies. The influence of the variation of the concentration of the coagulating electrolytes on the time of setting of the gel is shown in the table:

Amount of sol taken = 2 c.c.; total volume = 3 c.c.

Amount of *N*/5 K_2SO_4 (c.c.)	Time of setting (min.)	Amount of *N* KCl (c.c.)	Time of setting (min.)
0·28	2	1·00	4
0·26	4	0·80	8
0·24	7	0·60	12
0·22	10	0·40	20
0·20	15	0·20	52

These jellies are quite stable and can usually be kept for days without appreciable change. On vigorous shaking they assume a liquid form, and the viscous liquid so obtained again sets to a jelly on standing; this process can be repeated several times. These jellies are therefore thixotropic in nature.

My thanks are due to Dr. Satya Prakash for valuable suggestions and his interest in this investigation.

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Differentiation between Glucose, Galactose and Mannose by a Colour Reaction

Three naturally occurring aldohexoses—glucose, mannose and galactose—can readily be differentiated by the following method. Add 2 mgm. of the unknown sugar material to a solution of pyrocatechol at a concentration of 0·2 per cent in 85 per cent phosphoric acid syrup. Heat for 15 min. in a boiling water bath, shaking vigorously at the end of the first minute of heating to effect solution of the sugar. In these conditions, glucose produces a lilac colour, mannose produces a brown colour and galactose produces a red colour intermediate in quality between the colours afforded by glucose and mannose. The test is applicable equally to free and polymerized aldohexose. Amino-acids (apart from tryptophane) and gelatine do not produce colour in these conditions, and do not interfere even in large amount with this test.

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Influence of Gonadal Hormones on the Serum Lipochrome and Riboflavin of the Domestic Fowl

Trichloracetic acid filtrates of serum were prepared during an investigation of the effects of gonadal hormones on the mineral metabolism of the immature pullet. Such preliminary removal of protein is essential in determining serum calcium where much vitellin or phospholipid is present, as is the case in laying birds or birds treated with œstrogen. It was noticed that filtrates from the sera of the pullets (fourteen weeks old) were tinted a greenish-yellow colour in the case of those birds receiving heavier doses of œstrogen, while the sera of birds not receiving œstrogen were colourless. A direct dietary influence was excluded because the birds, which were of the same strain and hatching, had been reared together under the same conditions and had, for three weeks before the observations, received the same amounts daily of the same diet.

The fact that the trichloracetic acid precipitate removes lipid material as well as protein prompted an examination for the presence

Pullet No.	Total dose œstradiol dipropionate (Ciba) (mgm.)*	Total dose testosterone propionate (Ciba) (mgm.)*	Serum calcium (mgm./ 100 ml.)	Plasma lipochrome, (Lovibond yellow units)**	Serum riboflavin (p.p.m.)
25	0	0	12·6	0·6	trace ?
26	6	0	17·4	0·8	0·05
27	12	0	38·3	1·2	0·27
28	24	0	97	1·6	1·22
29	0	8·25	12·4	0·8	trace ?
30	6	8·25	28·6	0·8	0·09
31	12	8·25	76	1·4	0·39
32	24	8·25	100	1·7	1·25

* Divided into six doses administered intramuscularly on alternate days.
** Alcohol-ether extract (10 ml.) of 0·5 ml. plasma examined in 2 cm. cell.

of riboflavin as an acid-soluble coloured substance, which might conceivably be mobilized for egg production.

After adjusting the filtrate to *p*H 6·0, the solution displayed a fluorescence indistinguishable from that of standard riboflavin solutions. This fluorescence was destroyed by sodium hydrosulphite and it was, therefore, possible to make preliminary fluorimetric estimations of riboflavin. The relevant results are summarized in the accompanying table.

These observations suggest that the relations of gonadal hormone activity to the mobilization, and also possibly the metabolism, of certain vitamins in the fowl may offer a fruitful field for investigation. There is already evidence that variations in the vitamin A content of the human ovary are related to the production or storage of the sex hormones[1]. The mobilization of lipochrome (presumably carotenoids for the yolk) in the serum of the œstrogenized or actively laying fowl must also be familiar to all who have prepared phospholipid extracts from the sera of such birds. Again, the yellow colour of the distinctly flocky trichloracetic acid protein precipitate from such sera and the removal of this colour by alcohol-ether extraction gives a qualitative impression of the association of serum vitellin with lipochrome. However, to the best of our knowledge, such observations have not before been extended to water-soluble pigments such as riboflavin.

Further experiments are being undertaken to investigate the possible mobilization of other vitamins, particularly vitamin A and aneurin, as well as a further investigation of the effect on serum riboflavin.

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Use of Synthetic Resins in the Estimation of Trace Elements

If trace elements in plant material are to be estimated polarographically, a digest free from organic substances must first be prepared. Piper[1] has reported that appreciable losses occur during ashing, owing to the volatility of inorganic components and adsorption to the surface of the ashing vessel. Digestion with mineral acids and oxidizing agents on the other hand gives solutions of high total ionic concentration, and the polarograms, as shown by Reed and Cummings[2], are often vague. As in many colorimetric estimations, therefore, it is necessary to isolate elements from the digest before they can be estimated accurately. If several elements can be isolated simultaneously, there is the possibility of estimating them in a single polarogram.

It appears probable that trace elements may be isolated from a plant digest by the use of synthetic resins.

A column of bed volume 1 ml., packed with granules of Amberlite IR100, was washed and classified as recommended by McReady and Hassid[3], and taken through several successive exchange cycles with normal hydrochloric acid and normal ammonium chloride solutions. 2 ml. of a solution containing copper, cadmium, nickel, zinc and manganese salts, each in concentration approximately 4×10^{-4} *M*, was introduced to the purified column, and the adsorbed cations subsequently eluted with hydrochloric acid.

In the presence of normal ammonium chloride, the cations were not fully retained by the column, but appeared in the first fractions issuing. The excess cations in the original solution themselves displace the trace elements.

In the presence of decinormal salt solutions, however, cations were fully retained.

By varying the nature and concentration of the solution used in eluting the adsorbed cations, it should be possible to isolate them in successive fractions of eluate. For example, decinormal hydrochloric acid displaced only cadmium, whereas normal hydrochloric acid liberated the zinc, manganese, copper and nickel in addition. Although the proportions of the various cations varied in successive fractions of the effluent solution, a full separation was not achieved.

Cations may be separated from interfering anions during the passage through a column. Thus, with decinormal phosphate present in the original solution, the phosphate passed through and was recovered quantitatively, while the trace elements were adsorbed. Elution with hydrochloric acid gave the trace elements free from phosphate ions. This separation may prove useful in the treatment of plant extracts, in which a precipitate containing calcium and magnesium phosphates is formed when the *p*H is greater than 5. On the surface of this precipitate, trace elements are strongly adsorbed. For this reason it is not possible to use neutral or alkaline supporting electrolytes in the polarographic analysis of plant digests, unless the phosphate is first removed.

In the table, polarographic step heights (all converted to full galvanometer sensitivity) are reported without converting them to concentrations. In the ammoniacal buffer used as supporting electrolyte[4], the step heights are approximately proportional to concentrations within this range.

These high recoveries of trace elements present only in minute quantities suggest that the method may prove useful in analysing samples of plant material as small as 1 gm. with an accuracy better than 10 per cent (the value accepted in spectrographic determinations).

Since plant digests intended for passage through a resin column must have a low total ionic concentration, the normal treatment with involatile sulphuric and perchloric acids is unsuitable. Plant material which has been charred at 250° C. to remove volatile organic substances dissolves in fuming nitric acid, giving a pale yellow solution from which excess acid may be removed by evaporation. It is hoped that such a digest may prove suitable for chromatographic separations.

The isolation of anions by passage through a column of Amberlite IR4 may be somewhat more difficult, since the reaction rates here are smaller. Polarographic estimation of many anions is now possible, and, once these ions have been isolated from interfering substances, the appropriate supporting electrolyte may be selected for each estimation.

Temperature 20° C. $m^{2/3}\tau^{1/6}$ 1·76 mgm.$^{2/3}$sec.$^{-1/2}$

	Cu	Cd	Ni	Zn	Mn	
Total amounts of trace elements introduced in 2 ml. solution	1·26	1·42	1·36	1·22	$1·46 \times 10^{-6}$	gm.-equiv.
Corresponding measured step heights	165	335	306	352	227	mm.
A. Trace elements in *N*/10 amm. phosphate recovered by eluting with normal HCl						
First 10 ml.	120	318	218	316	178	
Second 10 ml.	35	4	73	33	28	
Third 10 ml.	0	0	5	6	0	
Total	155	322	296	355	198	
B. *N*/10 amm. phosphate alone (Blank for total reagents) 30 ml. *N*.HCl	12	0	4	28	0	
Total % recovery (Recovery in first 10 ml. eluate	87 70	96 95	95 71	93 87	87 78)	

This work was carried out at East Malling Research Station as part of the mineral deficiencies programme financed by the Agricultural Research Council. I wish to thank Dr. G. A. Gilbert for suggesting the use of synthetic resins, and Charles Lennig and Co., Ltd., for arranging a supply of the Amberlite resins through their principals, the Resinous Products and Chemical Company.

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A New Virus Disease of Tomatoes

In the 1944 growing season a number of tomato plants grown as an outdoor crop under commercial conditions were noted as being infected with a virus disease. Subsequent work on this disease has revealed that it has been hitherto unrecorded. The purpose of this note is to put on record the disease which has since been found on a number of commercial holdings. Further details will be published shortly, but the effects of the disease appear to warrant this preliminary statement.

Affected plants are noticeably stunted and there is in the early stages marked growth of the axillary shoots giving a 'bushy' appearance to the plant. The growing point of the stem is malformed and may be suppressed by the disease, and this apparently increases the proliferation. At the same time, marked proliferation takes place on the main rachis at the bases of the individual leaflets, after 'stopping' and 'disbudding' in the normal way. Further, the fruits on the upper trusses of infected plants, that is, those which were formed after infection, are almost without exception entirely seedless and are usually very much smaller than normal seeded fruits. The complete suppression of seed formation is of special interest as regards the effect of virus diseases on megaspore and microspore formation[1].

The disease is sap-transmissible and readily induces systemic infection in *Nicotiana tabacum* and in *N. glutinosa*. Symptoms appear two or three weeks after inoculation in both cases. In *N. tabacum* a green-yellow mosaic is produced with some ring spotting; in *N. glutinosa* necrosis and leaf distortion are accompanied by a dark green 'blistering' effect. There are no local lesions on the inoculated leaves.

Sap transmission of the disease into tomato was found to occur less readily than into *N. tabacum* and *N. glutinosa*, and repeated sap inoculations into a range of other solanaceous plants were unsuccessful.

The virus is markedly non-persistent in extracted sap, remaining infective for only one or two days at room temperature. It is inactivated by heating for ten minutes at 50° C.

The distribution of diseased plants in the bed where the disease was first noted indicated that a block of chrysanthemums growing near by might well be the source of infection, and this has since been confirmed. A virus identical in behaviour with that obtained from the diseased tomato plants has been obtained from the chrysanthemums. The symptoms in chrysanthemum are not well developed, the plants being somewhat stunted, with some chlorosis in the leaves.

Observations on the disease in field crops of tomatoes under both experimental and commercial conditions have shown that the spread is rapid and that it can cause serious reduction in the yield of fruit—the fruit on infected plants being so undersized as to be valueless. Field experiments indicate that an aphis is the vector. Mechanical transfer of the virus in 'stopping' and 'tying in' the plants does not appear to be a probable method of transmission.

It is hoped to complete detailed investigations on the spread and effect of the disease and on the nature of the vector in the course of the present growing season.

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Effect of Copper-Enzyme Poisons on Soil Nitrification

THE possible biological importance of an activated copper nitrogen complex has been repeatedly stressed by Baudisch[1]. I have therefore tried the effect of some well-known copper-enzyme poisons on soil nitrification, which is the process whereby ammonium ions are oxidized to nitrite ions and thence to nitrate ions by the microflora in soil. The percolation apparatus used in this work was an improved and simplified version[2] of the one already described[3].

Ten grams of a Kent marsh soil were initially percolated with 100 ml. of *M*/200 ammonium chloride to stimulate nitrifying activity in the soil. When the soil was nitrifying well (as indicated by a rapid rise of nitrate in the percolate) the percolate was discarded and the soil rinsed three times with 50 ml. lots of a *M*/250 solution of one of the poisons. After the poison had been in contact with the soil for two hours, excess was washed out with 3 × 50 ml. lots of distilled water and the soil repercolated overnight either with 100 ml. distilled water or with 100 ml. of a *M*/1,000 solution of cupric, ferrous or manganous sulphate. The next morning this new percolate was again discarded and replaced by 100 ml. of *M*/200 ammonium chloride. The nitrite-nitrogen plus nitrate-nitrogen concentration in the percolate was thereafter estimated daily by phenoldisulphonic acid and the amount of nitrite-nitrogen plus nitrate-nitrogen formed per gram of soil calculated from the results.

The results from a number of different experiments show that all the four poisons tried reduced the rate of nitrification in soil. There is furthermore evidence that cupric, and perhaps ferrous, ions are capable of partially reversing the poisoning effect.

MICROGRAMS OF NITRITE PLUS NITRATE-NITROGEN FORMED IN TWO DAYS PER GRAM OF KENT MARSH SOIL

Poisoned with	Perfused overnight with Water	$CuSO_4$	$FeSO_4$	$MnSO_4$
M/250 potassium ethyl xanthate	tr.	120	50	70
M/250 sodium diethyl dithiocarbamate	20	220	50	20
M/250 salicylaldoxime	10	180	120	0
M/250 allylthiourea	50	50	50	50
Unpoisoned control	400	*	*	*

* A separate set of control experiments showed that the metal solutions themselves had no effect on the nitrification rate.

Experiments in which the oxidation of nitrite to nitrate by soil was studied separately gave results that showed a similar action of copper poisons on this process. The effect here was not, however, quite so strong.

The results suggest that copper and/or some allied elements play an important part in the oxidation of ammonium ions in soil by the soil microflora. Preliminary results obtained by Drs. Mann and Heintze in this laboratory show that the rate of oxidation of manganous ions may also be reduced by these same copper-enzyme poisons. Reactivation is, however, difficult here because of the toxic action of quite dilute copper solutions on manganese oxidation.

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Anti-Oxygen Stabilization of Bilirubin in Alkaline Medium by Ascorbic Acid and Cysteine

WE have shown in earlier publications[1,2] that ascorbic acid and cysteine prevent the oxidation of bilirubin in alkaline medium. The effect of both substances was ascribed hypothetically to their anti-oxygen properties. The mechanism of action of the anti-oxygen agents had not been elucidated. On the other hand, the protective action of ascorbic acid and cysteine for bilirubin might equally be explained as a reducing one. If such a view is valid, one would expect oxidized bilirubin to be promptly reduced in alkaline solution, when vitamin C or cysteine is added.

This hypothesis has been verified as follows: 10 mgm. bilirubin Hoffmann–La Roche, identical with Fischer's product, are dissolved in 500 c.c. *N*/50 sodium hydroxide. The oxidation of the pigment, which begins almost immediately, is characterized photometrically, as in previous experiments in collaboration with A. Lambrechts[3], by a continuous decrease of absorption in the region of 4300 A. 24 hours later, while the initial extinction coefficient at 4300 A. is 1·84 for a stabilized bilirubin solution, the oxidized bilirubin solution, on the contrary, shows a considerable decrease in its absorption, its extinction coefficient being 0·22. To two 100 c.c. samples of this oxidized bilirubin solution, we then add respectively 40 mgm. ascorbic acid and 94 mgm. cysteine hydrochloride neutralized by 10 per cent sodium hydroxide. These solutions are immediately examined by means of the Pulfrich photometer, and again after 3 and 6 hours. The accompanying table shows the photometric values recorded.

S.	Oxidized bilirubin + ascorbic acid			Oxidized bilirubin + cysteine		
	K immed.	*K* after 3 hr.	*K* after 6 hr.	*K* immed.	*K* after 3 hr.	*K* after 6 hr.
43	0·22	0·22	0·23	0·22	0·22	0·21
45	0·12	0·12	0·13	0·14	0·12	0·11
47	0·04	0·04	0·05	0·05	0·03	0·03
50–75	0·00	0·00	0·00	0·00	0·00	0·00

Conclusions. Ascorbic acid and cysteine do not reduce oxidized bilirubin in alkaline medium. It rather seems that both substances prevent directly the oxidation of bilirubin. In collaboration with R. Roseman[4], similar observations were made with some polyphenols easily oxidized in alkaline solutions. The experiments are being continued.

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Colour Receptors of the Human Fovea

AS soon as the results of Granit's micro-electrode experiments on the retinæ of animals were published, it was clear that a method was wanted for obtaining similar information with regard to the colour vision of man. This led to the development of the retinal micro-stimulator, which consists essentially of a microscope used in reverse, so that greatly diminished images of suitable test light-sources are presented to the eyes of the observer.

With apparatus of suitable design, it is possible to test, point by point, the colour vision of a chosen area of the retina. The dimensions I have used are such that each centimetre on the plotting-board of the apparatus corresponds with 'the cone intercentre distance', that is, the distance between the centre of one foveal cone and that of its next-door neighbours. It has been found possible to record the positions of the test light-sources with an accuracy corresponding to one tenth of this distance. A number of experiments have been performed with this technique, but those to be reported here concern the theories of colour vision. As is well known, Thomas Young's trichromatic theory postulated three colour sensations: red, green and blue. Granit, on the other hand, found in the retinæ of several types of mammals one 'dominator' and seven 'modulators'. The former was a sense-organ which responded to stimulation by light coming from most of the visible spectrum. The latter, on the contrary, were receptors with responses limited to a narrow part of the spectrum only. Granit found 'modulators' with maxima at the following wavelengths in Angströms: 6000, 5800; 5400, 5200, 5000; 4600 and 4400. Thus, whereas the difference between two neighbouring units was usually two hundred Angströms, in two places the difference was double that amount, hence dividing them into three groups: yellow-orange, green and blue-violet.

Granit's conclusion was that each of the hypothetical 'sensations' of Thomas Young consisted of two or more kinds of 'modulator'. It should be pointed out, however, that whereas Granit's work has been performed on animals, Thomas Young's theory was intended to apply only to man. Physiologists are rightly cautious in such a case as this, for what is found with the former may differ widely from what is found with the latter.

The following results have been obtained. When white light from a small metal filament electric lamp is caused to move slowly over the fovea, as a narrow exploring pencil, in some places it appears red, in other places green, and in still other places blue. When red, it matches in colour a pencil of red light of 6400 A.; when green, it matches a pencil of green 5400 A.; and when blue, it matches blue of 4800 A. The precise position in the fovea of some of these specific points has been determined with reference to the point of fixation, by measuring the distance between the white test-light and the monochromatic light on which the gaze is fixed. Between these foveal points with specific colour responses are numerous other points having a non-specific response which may be either white or yellow.

A monochromatic orange light of 6200 A. is seen as red in some foveal positions, and as pale orange in others. Sometimes a minute black spot, due to the presence of an unstimulated receptor, is perceived. A monochromatic yellow light of 5800 A. behaves like a white light, in sometimes appearing white (or pale yellow), sometimes red, sometimes green and sometimes orange. A monochromatic green light of 5400 A. sometimes appears green, and sometimes very pale green or even white, as it is moved slowly from place to place over the fovea.

These experiments point to the following conclusions.

(1) Thomas Young's trichromatic theory of colour vision is substantially correct, since the above tests are held to prove the existence of red receptors, green receptors and blue receptors, in the human fovea.

(2) In addition to the receptors postulated by the above theory, there are either yellow receptors, white receptors, or both. In this respect the results so far obtained agree with the results obtained by Prof. Ragnar Granit who, as stated above, used the micro-electrode technique on the eyes of animals.

(3) Fixation can be extremely precise, since the effects of eye-movements do not show themselves.

(4) It is possible to stimulate by light, either single cones, or very small groups of cones indeed.

(5) It has been possible to identify, with the precision of at least half 'the cone intercentre distance', the position of some of the receptors which possess specific colour properties.

No evidence has so far been obtained that the green and blue sensations of human vision are due to the combined responses of several different kinds of receptor operating in narrow regions of the spectrum. It is hoped that further research with the microstimulator will help to elucidate this point.

I should like to thank Dr. John D'Silva, who acted as recorder for many of the above observations.

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Carcinogenic Substance from Human Cancer

J. F. MENKE[1] obtained lipid extracts from human breast cancer which, when injected into white mice, induced, in seven of thirty-six animals so treated, the development of sarcomas at the site of injection. In our experiments analogous extracts were prepared from various human cancers. Two extracts were prepared from gastric carcinoma, three extracts from breast carcinoma, and two extracts from fibrosarcoma. Each of the extracts was tested separately.

Four-months-old white mice of our own breeding were used in the experiments. Our strain of mice has a negligible incidence (less than 2 *pro mille*) of spontaneous tumours. The animals received 10, 20 or 30 mgm. of the lipid extract suspended in sweet almond oil, as a single subcutaneous injection. No differences were noted in the effect with variation of the doses within these limits. Of ninety-four mice injected with the extracts, twenty died within the first four months of the experiment. Of the remaining seventy-four mice, twenty-one animals (28·4 per cent) developed malignant tumours.

The tumours developed chiefly in organs at a distance from the site of injection, and exhibited various histological types including carcinoma and sarcoma. Gastric carcinoma extracts provoked two breast carcinomas (in two females), two lung lymphosarcomas (in one male and one female), and one lymphosarcoma at the site of injection (in one female). Breast carcinoma extracts provoked four breast carcinomas (in four females), one lung lymphosarcoma (in one female), one liver carcinoma (in one male) and two lymphosarcomas at the site of injection (in two females). Fibrosarcoma extracts provoked four breast carcinomas (in four females), one lung lymphosarcoma (in one female), one lung carcinoma (in one male), one kidney carcinoma (in one male), and one lymphosarcoma at the site of injection (in one female).

All seven extracts tested induced approximately the same percentage of tumours in the animals treated. The average period of time necessary for the development of tumours was 6 months for the gastric carcinoma extracts, 11 months for the breast carcinoma extracts, and 7·6 months for the fibrosarcoma extracts.

Of the fifty-three animals which died without developing tumours, the individuals survived as follows: four for 5 months, eight for 6 months, five for 7 months, seven for 8 months, four for 9 months, two for 10 months, two for 11 months, three for 12 months, and eighteen longer than 12 months.

Attempts undertaken with the aim of separating the active factor from the extracts resulted in a marked diminution of the number of malignant tumours provoked. Of fifty-seven mice injected with the chemically modified extracts, only six animals developed cancer. The average time for the development of the tumour after the single injection was approximately twice the time observed with the non-modified extracts.

Lipid carcinogenic extracts have been obtained from human livers[2–8] and from beef pituitary glands[9]. These experimental findings indicate that a lipid carcinogenic substance, probably of hormonal character, can be extracted from certain organs. Our experiments demonstrate that an analogous substance is present in human cancers. For this substance we propose the name 'boardin', which is accepted in our laboratories. Attempts are in progress to separate boardin from the extracts.

The histological diagnosis of the tumours was verified by Dr. Francis Carter Wood, to whom we are indebted for his co-operation.

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Transmission of *Litomosoides carinii* to Mice and Hamsters

Litomosoides carinii is a filariid parasite of the cotton rat, *Sigmodon hispidus*. It has been used extensively in the United States to investigate the chemotherapy of filarial infections. R. W. Williams and H. W. Brown[1] and J. A. Scott (private communication) have recently shown that infection was transmitted from one animal to another by means of the tropical rat mite *Liponyssus bacoti*. These workers kindly showed their results and methods to one of us and provided us with a colony of the mites and some infected cotton rats. Further infected cotton rats were kindly lent us by Prof. R. M. Gordon.

The transmission of *Litomosoides* to clean cotton rats and to laboratory (piebald) rats has been confirmed in this Institute, microfilariæ being found in the blood of the rats 63 days after the first exposure to infected mites. The blood of some of these rats has contained as many as 450,000 microfilariæ per c.c.

In addition, the attempt was made to transmit the infection to other laboratory animals. Nine albino mice were exposed to infected mites for 40–70 days. After 42 days, one mouse was killed and nine worms, measuring 5–14 mm. long, were found in the pleural cavity. The blood of the other mice was examined at somewhat irregular intervals. Microfilariæ were found in the blood of two mice, each on a single occasion, on the eighty-second and ninety-first days respectively after the beginning of the exposure to infection. No microfilariæ have been seen in the blood of the other six mice up to the ninetieth day. Three hamsters (*Cricetus* (*Mesocricetus*) *auratus*) were exposed to infection for periods of 26–44 days. One hamster died after 39 days; five worms, measuring 1–3·2 cm. long, both sexes being present, were found in the pleural cavities. Another hamster was killed after 44 days; the pleural cavities contained thirty-four worms, 1–3 cm. long, both sexes being present. In the case of the third hamster, microfilariæ were found at the first examination of the blood made on the seventieth day and on subsequent occasions, the number present being small.

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London, N.W.3. June 22.

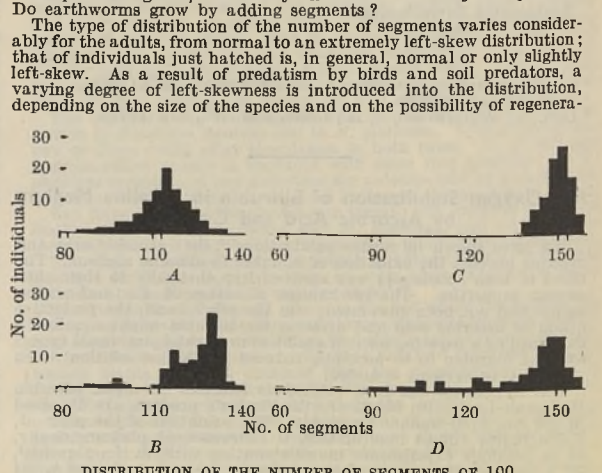
[1] Williams, R. W., and Brown, H. W., *Science*, **102**, 482 (1945); **103**, 224 (1946).

Distribution of Number of Segments in Earthworms and its Significance

DURING the course of an investigation into the relations between earthworms and the fertility of the soil, it has been found necessary to study the biology of the several species found in grassland in some detail since, in spite of their natural abundance, possible importance and extreme commonness as a type in zoological classes, very little is known about their biology, distribution on different types of soil, seasonal activities, etc. One of the factors making such a study difficult has been the fact that the specific characters are largely based on the position of the clitellum and tubercula pubertatis, which only appear at the onset of sexual maturity. Thus in a representative sample of worms only a small proportion are identifiable.

It has been the custom of systematists when describing species of earthworms to state the approximate number of segments, but little emphasis has ever been placed on this character. In an attempt to identify the numerous immature specimens collected during the past year, a detailed study has been made of the variation in the number of segments for a number of species. The results show that each species has a typical number often differing widely between nearly related members of the same genus, so that, taken in conjunction with other somewhat vague characteristics, about 95 per cent of the immature specimens in a collection can be identified. The departure of the distribution of the number of segments of adults from the normal distribution of the number for individuals just hatched can lead to interesting conclusions regarding the amount of predatism to which a species is subject, the presence or absence of regeneration in a species or genus, and finally an answer to a very old question, Do earthworms grow by adding segments?

The type of distribution of the number of segments varies considerably for the adults, from normal to an extremely left-skew distribution; that of individuals just hatched is, in general, normal or only slightly left-skew. As a result of predatism by birds and soil predators, a varying degree of left-skewness is introduced into the distribution, depending on the size of the species and on the possibility of regenera-



DISTRIBUTION OF THE NUMBER OF SEGMENTS OF 100 INDIVIDUALS

A, *A. chlorotica*, adult; *B*, *E. rosea*, adult; *C*, *L. terrestris*, recently hatched; *D*, *L. terrestris*, adult.

tion in the species. Thus for adults of *Allolobophora chlorotica* Sav., the distribution is normal; for *Eisenia rosea* Sav., it is significantly left-skew; and for *Lumbricus terrestris* Linn., highly significantly left-skew. In the cases of *A. chlorotica* and *E. rosea*, regeneration of the lost segments has mitigated the effect of predators on skewness, but in the case of *L. terrestris* (and two other members of this genus) regeneration of the lost segments does not seem to occur, with the result that the normal distribution for worms just hatched becomes more and more skew with increasing age.

Finally, the answer to the question, Do earthworms grow by adding segments?, is not the simple negative given by Sun and Pratt[1] but rather that some species possess the adult number of segments at hatching, in others the number of segments increases during growth and in the genus *Lumbricus* growth occurs in spite of a decrease in the mean number of segments with increasing age.

A full account of this work will be published later.

A. C. Evans

Rothamsted Experimental Station,
Harpenden, Herts. June 19.

[1] Sun, K. H., and Pratt, K. C., *Amer. Nat.*, **65**, 31 (1931).

Life-History of a Species of *Metapenaeus* in Australian Coastal Lakes

The Penæid prawns, which are the basis of a valuable commercial fishery in the warmer countries of the world including, in particular, India, Australia, the Western Pacific and the southern shores of the United States, have a very special interest for zoologists.

This interest is bound up with the very remarkable fact that in opposition to all other Decapod Crustacea (including the common prawns and shrimps of northern Europe) the Penæid prawns do not carry their fertilized eggs under the abdomen but emit them into the sea, where they hatch out as typical nauplius larvæ.

The existence of this primitive type of development was discovered some years ago and aroused the curiosity of zoologists, but many years were to pass before even a moderately complete sequence of developmental stages could be directly associated with a known Penæid species.

Apart, however, from the scientific value of a knowledge of the larvæ, there is another reason for making special studies of the life-history of some of these Penæid species. To conserve any fishery it is essential to know the habits of the species concerned. The prawn fishery of the South Atlantic and Gulf coasts of the United States is the third in value of all fisheries of that eastern seaboard. The prawn industry of New South Wales, Australia, although not so valuable as that of the United States, is important, and up to a few years ago the scientific problem was made particularly interesting because the breeding habits of the favoured commercial species (*Penæus plebejus*, Hesse) were completely unknown. These prawns were very rarely caught with maturing gonads, and the few I obtained with well-developed gonads came from the ocean and the seaward margin of Port Jackson, whereas the prawn fishery is only carried on inside certain estuaries and in curious coastal lakes which are often cut off from the sea altogether for a year or more at a time.

Early in the year 1938, my first work dealing with the development of the well-known New South Wales commercial prawn, *Penæus plebejus*, was published[1]. It must be pointed out that our task was made rather difficult by the fact that it had to be proved first that this prawn left the estuaries and lakes and migrated to the ocean for breeding. There it was shown to increase in size to a remarkable extent as the gonads developed to maturity. This migration of *Penæus plebejus* was clearly demonstrated. The different larval stages had thus to be collected at sea where the larvæ of different species can easily confuse the issue.

Later in the same year an excellent memoir by Jeanne H. Heldt[2] appeared, which described more fully and definitely the life-history of certain Mediterranean species. The eggs of three species were set free from adults in the aquarium at Salammbo and hatching and rearing took place in aquaria.

To complete the coincidence of interest in Penæid research the year 1939 brought forward a publication giving the results of at least six years work by American authorities on their commercial species[3]. Apparently the American workers found similar migrations to the ocean and had to depend at first on plankton catches for material. Very satisfactory series of larvæ were obtained.

In the course of our early New South Wales investigations one species of Penæid (a species regarded at the time as of little or no importance in the fishery, and the existence of which was apparently unrecognized by some fishery authorities) was caught inside the shallow coastal lakes with gonads in a fair state of development. The exceptional fact was noted, but the war years prevented our obtaining any other specimens of this species at the breeding season. During the last twelve months an intense study of this species has not only led to the discovery of a fine series of the early stages but also has demonstrated that this Penæid actually becomes mature inside the shallow coastal lakes and breeds there.

The species (known locally as the 'greasy back') has usually been regarded as *Penæopsis monoceros* (Fabricius, 1798) or *Metapenæus monoceros* Alcock, a species of very wide range extending not only to India, but also, by migration through the Suez Canal, to the Mediterranean. However, there are some grounds, according to Burkenroad, for regarding the 'greasy back' of New South Wales as a new species of *Metapenæus*[4].

A complete account of the life-history is being published.

W. H. Dakin

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[1] Dakin, W. J., *Proc. Zool. Soc., Lond.*, Ser. A, **108**, Pt. 2 (1938). See also Dakin, W. J., *Records Aust. Mus.*, **20**, No. 5 (1940).
[2] Heldt, Jeanne H., *Ann. l'institut oceanographique*, **18**, Fasc. 2 (1938).
[3] Pearson, John C., *Bull. Bur. of Fisheries, Washington*, **49**, Bull. 30.
[4] Burkenroad, Martin D., personal communication.

Relativity Transformations Connecting Two Systems in Arbitrary Acceleration

The physical meaning of every term in the Lorentz transformation is now clear, thanks to the investigations of Einstein. Unfortunately, the general Lorentz transformations usually given as

$$\vec{r} = \vec{r'} + \vec{v}\,\frac{(\vec{v}\cdot\vec{r'})}{v^2}\left(\frac{1}{\sqrt{1-\beta^2}} - 1\right) + \vec{v}\,\frac{t'}{\sqrt{1-\beta^2}},$$

$$t = \frac{t' + \frac{1}{c^2}(\vec{v}\cdot\vec{r'})}{\sqrt{1-\beta^2}}$$

do not possess some of the beautiful properties of the original linear motion transformations owing to the non-group nature under successive velocity transformations and to the non-symmetry with respect to the space-time co-ordinates. I think something should be done about this.

After making clear the idea of contraction of length and clock and the misadjustment of the clocks, one is inclined to ask *when* the clocks and scales will be so contracted as the system *just starts* to move. Einstein did not trouble himself with this question as the system is, was and will always be in uniform motion, an idea handed down from Newton's time. It is therefore immaterial *when* it contracts or *when* the clocks are misadjusted. Students, however, usually come to me with the question as to whether the two ends of a rigid stick contract towards its centre. This is obviously not so, for many short sticks joined end to end would leave spaces between them after contraction, a fact certainly against the principle of relativity if not logic. Also, distant sticks cannot contract instantly as soon as the system starts to move, for no velocity of signalling can be greater than the velocity of light and there does not exist a rigid body system in relativity. A very, very long stick must have an enormous velocity at its ends in order to complete this contraction within the short interval during which the system attains its final velocity! To answer such and kindred paradoxes it is necessary to go back once more to the physical principles underlying the contraction and misadjustment of the clocks in the special theory of relativity. Take, for example, the synchronization problem treated by Einstein. The misadjustments of the clocks at different places of the moving system are due to the light signal connexions between places where clocks are to be synchronized; that is, the observers *did not and could not adjust their clocks instantly*. We certainly synchronize our clocks with, say, Greenwich by its constant radio signals and adjust our clocks by allowing for the time of travel. Our friends on the moving system would probably do the same thing and, being ignorant of their motion, have misadjusted their clocks! (The terms *rest* and *motion* here are only relative. But for the sake of clarity, we shall speak of a *moving* and a *rest* system as if it exists, and shall prove their relativity only afterwards.) Similarly, we find such effects in the apparent contractions of lengths and clocks. With this explanation, it is now possible to answer some perplexing problems encountered in Einstein's special relativity. The clocks, etc., are *apparently* affected through a *time delay*. Following this thought, we can work out the effects on clocks, etc., due to acceleration.

Since all the measuring standards along the light signal tracks emitted from the 'origin' of the moving system are affected similarly, according to the Lorentz formulæ with the instantaneous velocity of the 'origin', therefore

$$x - \xi = \frac{x' + v\,(t' - \tau')}{\sqrt{1-\beta^2}}\,;\quad t - \tau = \frac{t' - \tau' + \frac{v}{c^2}\,x'}{\sqrt{1-\beta^2}}\,;$$

where the primed letters refer to the moving system, unprimed to the rest system, and where $c(t-\tau)$ is simply the distance between an arbitrary point P, where the clock is to be synchronized with the origin, and the origin the velocity of which at time $\tau = t - r/c$ is v and acceleration Γ_x. The clock at the moving origin will register a time $\tau' = \int\sqrt{1-\beta^2}\,d\tau$ due to the successive Lorentz contractions. From them we obtain $r'/c = t' - \tau'$ and the differential coefficients:

$$dx = \frac{dx' + v dt'}{\sqrt{1-\beta^2}} + \frac{r'\Gamma_x}{c(1-\beta^2)\,(1-\beta_r)}\left(dt' - \frac{dr'}{c}\right);$$

$$dt = \frac{dt' + \frac{v}{c^2}\,dx'}{\sqrt{1-\beta^2}} + \frac{r'\Gamma_r}{c^2(1-\beta^2)\,(1-\beta_r)}\left(dt' - \frac{dr'}{c}\right);$$

where

$$\Gamma_x = \frac{dv}{d\tau}\,,\ \Gamma_r = \Gamma_x\,\frac{x-\xi}{r}\,,\ \beta_r = \frac{v}{c}\,\frac{x-\xi}{r},$$

and

$$d\tau = \frac{d\tau'}{\sqrt{1-\beta^2}} = \frac{dt' - \frac{dr'}{c}}{\sqrt{1-\beta^2}}.$$

The interpretations of these terms are interesting, but we shall only mention some practical applications here. From these transformation coefficients it is easy to obtain the electromagnetic field due to an

arbitrary moving charge from its Coulomb's field[1]. Strange to say, those obtained from this transformation agree perfectly with the field usually obtained through the solution of Maxwell's equations. This not only demonstrates that our physical idea is probably correct, but also shows how remarkable Maxwell's equations are, in perfect harmony even with this idea of relativity of acceleration. The inverse coefficients, solved from the above by determinant methods, should give the field as observed by an accelerated observer but due to a charge at rest. The results agree, using the apparent velocity and acceleration, beautifully with the field due to an accelerated charge. I think this can be experimentally verified. Can we now believe in the relativity of acceleration?

The contraction coefficients or effects are remarkable when we compare them with the results deduced from Einstein's principle of equivalence and his gravitation theory. But I believe the advance of the perihelion of Mercury and the deflexion of light beams can be obtained without the use of his theory of gravitation[2].

The relative nature of acceleration is apparent when we remember that at every instant the relativistic formulæ of Lorentz were used, that is, the motion has been relative all the time. The inverse transformation coefficients illustrate such relativity most clearly.

Some new difficulties come in when we assert the relative nature of acceleration. Acceleration is not like uniform motion, which Newton claims does not need any *cause* to maintain it. If I accelerate, I shall find that all the matter in the universe is accelerating towards me. What are the causes for such *en bloc* motions? (This difficulty also appears for uniform motion, though it is usually ignored. It is also strange for the *en bloc* uniform motion of all the matters in the universe *if* I move uniformly.) I shall not take Einstein's principle of equivalence as the answer, for it might equally well be asked where the gravitational field comes from, as gravitation must be caused by matter even in Einstein's general theory.

I cannot answer these questions at present (this paper is far from complete, and would not be presented for publication if not for the fact that our University is moving to Hangchow and will not settle down for at least six months), but I wish to point out that these *en bloc* accelerations are not quite true, and that the acceleration is not quite arbitrary as we may think at first when considering a man walking arbitrarily. Acceleration, as we know, is connected with the distance of the particle from other particles and 'a man walking' is an intricate macroscopic many-body problem. However, on multiplying the general $\partial t/\partial t'$ coefficient by m_0c^2,

$$m_0c^2\,\frac{\partial t}{\partial t'} = \frac{m_0c^2}{\sqrt{1-\beta^2}} + \frac{r'm_0\Gamma_r}{(1-\beta^2)\,(1-\beta_r)} \doteq m_0c^2 + \frac{1}{2}\,m_0v^2 + r'F_r,$$

we see that it must be in the nature of energy. The first term corresponds to Einstein's kinetic and rest energy, the second term must correspond to potential energy. But the potential energy is ordinarily defined by an *integral* $V = -\int \vec{F}\cdot\vec{dr}$. For the two expressions to agree, it is necessary that, for small velocities and large distances,

$$V = rF_r = -\int \vec{F}\cdot\vec{dr}.$$

The only solution of this equation is $F = \lambda/r^2$, where λ is an arbitrary constant. Thus we see that the ordinary notion of force, at least in this specified inverse square law, is intimately connected with the relativity of acceleration, and there is really not much difficulty in getting rid of the idea of force altogether.

Finally, I wish to thank M. H. Wang, K. C. Chen and S. C. Kiang for collaboration and for their valuable suggestions. I must also thank Prof. K. C. Wang, Prof. T. L. Ho, both professors of physics in this University, Dr. Y. F. Tseng, deputy chief secretary to the Central Executive Committee, and my young brother Dr. C. P. Soh, publisher of the *Shanghai Herald*, for help and constant encouragement. To my brother especially, who has aided me financially, I tender my deep gratitude.

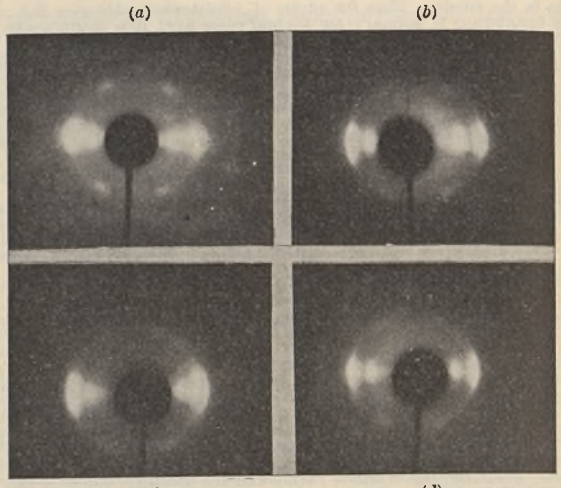
HSIN-PEI SOH

Department of Physics,
National Chekiang University,
moving to Hangchow, Chekiang, China.
April 14.

[1] *Nature*, **157**, 809 (1946).
[2] Compare, for example, Cheng, *Nature*, **155**, 574 (1945), who considers only first-order *contraction* effects.

Effect of Dyeing, Mercerizing and Intensively Delignifying Jute Fibres on their Structure

THOUGH jute is a commercially important fibre, the study of its internal structure has not received so much attention as other cellulose fibres such as cotton and ramie. X-ray investigations of jute have recently been started in India. Banerjee and Roy[1] have found that the lattice structure of the cellulose crystallites in jute is identical with those in other cellulose fibres. The presence or absence of resins, fats and lignin does not produce any change in this structure. They have also found that the mean dimensions of the cellulose crystallites in jute are of the order of 62 A. along the fibre axis and 25 A. and 40 A. along the a and c axes respectively, so they are much smaller than those in ramie or cotton. The work is being carried out by Sircar, Rudra and Saha[2].



a, RAW JUTE DYED WITH CONGO RED. *b*, RAW JUTE DELIGNIFIED. *c*, RAW JUTE MERCERIZED AND DYED WITH METHYLENE BLUE. *d*, RAW JUTE DELIGNIFIED AND DYED WITH METHYLENE BLUE

X-ray photographs of jute fibres that have been subjected to intensive delignification have been taken by us. We have found that extensions of the spots take place so as to form arcs through them along the directions of the Debye–Scherrer rings. The positions of maximum intensity on the spots or their diffuseness along the radial direction are quite unaffected (Fig. 1*b*). This shows that lattice structure of the cellulose crystallites and their sizes are unaffected, while their ordering along the fibre axes has considerably deteriorated. The milder delignifications, however, as noted by the previous workers, do not produce this change. It is therefore concluded that a fraction of the lignin in jute helps to align the cellulose crystallites to parallelism and form bundles or fibrils of cellulose. This part of the lignin is much more difficult to remove than the remainder, in which apparently these fibrils are imbedded.

The effect of dyeing raw, completely delignified and partially mercerized jute fibres with Congo red and methylene blue has also been studied by X-rays. In the cases of raw (Fig. 1,*a*) and delignified jute fibres, it has been found that the X-ray pattern does not undergo any change, showing that the crystalline portion remains unmodified in structure as well as in alignment with respect to the fibre axis. It is particularly interesting that the dishevelling that is produced by the intensive delignification also remains unchanged (Fig. 1,*d*). This shows that the absorption of these organic dyestuffs is a superficial effect. Jute fibres treated with 25 per cent caustic soda solution at a temperature between 25° and 30° C. for half an hour showed diffraction spots corresponding to both native cellulose as well as mercerized cellulose. Dyeing by means of these organic dyestuffs also did not, in this case, produce any change in this partially mercerized structure (Fig. 1,*c*). So the crystallites of mercerized cellulose also are quite unaffected by the process of dyeing, both as regards internal structure as well as alignment.

We wish to thank Prof. K. Banerjee for suggesting the problem and for advice during the progress of the work.

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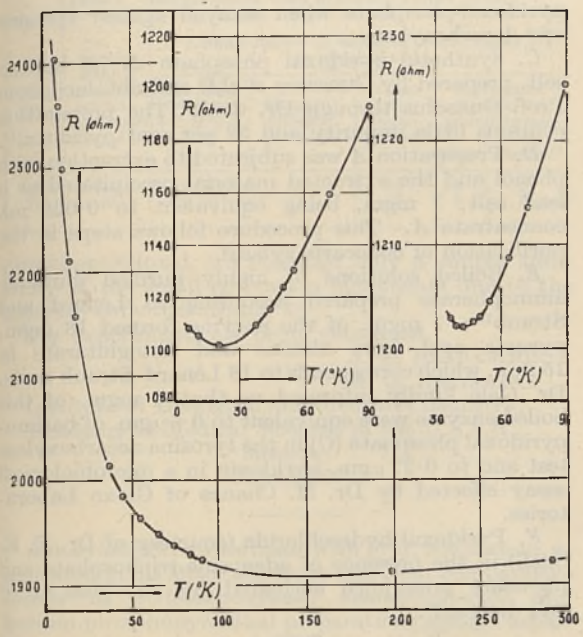
Calcutta.
May 2.

[1] Banerjee, K., and Roy, A. K., *Proc. Nat. Inst. Sci. India*, **7**, 376 (1941).
[2] Sircar, S. C., Saha, N. N., and Rudra, R. M., *Proc. Nat. Inst. Sci. India*, **10**, 325 (1944).

Resistivity of Thin Nickel Films at Low Temperatures

IN an earlier communication[1], we reported on measurements on the electrical resistance of thin nickel films. We found at that time that for a thickness greater than 40 mμ the films possess a positive temperature coefficient, whereas for smaller thicknesses the temperature coefficient is negative. The films were made by cathodic sputtering.

We have now measured the resistance of such films as a function of temperature down to liquid helium temperatures. We were able actually to observe that, on cooling films thicker than 40 mμ down to very low temperatures, the electric resistance passes through a reversible minimum and the temperature coefficient changes from positive into negative. The nearer the thickness approaches to 40 mμ, the more the minimum in the resistance curve is displaced towards higher temperatures. So we were able to observe that for one resistance the minimum was in the neighbourhood of about 150° K. In the accompanying figure are curves obtained for three films showing minima in the resistance curve.



It is interesting to direct attention to the analogy existing between these results and the minima found by de Haas and van den Berg[2] for the resistance of gold wires at liquid helium temperatures.

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June 14.

[1] *Nature*, **156**, 634 (1945).
[2] *Physica*, **3**, 440 (1936); **4**, 663 (1937).

Additional Interference Fringes Produced by Scattering and Reflexion

In a recent observation, F. K. Bauchwitz and D. Shoenberg[1] have reported observing a new interference effect. With the eye accommodated for infinity, they observed coloured circular fringes when looking at a strong point source through a thin air-film formed between silvered plates. The interpretation they give is that the light is first multiply reflected between the surfaces and then scattered, and this scattered light is multiply reflected before being observed.

The colours of thick plates which had been originally observed by Newton were interpreted by Young and by Stokes[2] in a similar manner to this, except that the interference pattern is produced by reflexion and not transmission. While preparing some optical flats a few years ago, interference patterns were noticed which differed from the usual Newton ring pattern and these were investigated. Experiments were carried out which showed that the patterns are produced by scattering and reflexion, and in the process the patterns seen by Bauchwitz and Shoenberg were independently observed as well as a double system of interference fringes, of which, to my knowledge, no previous description has been given.

This double system of fringes, consisting of a pair of patterns similar to the simple Newton ring type for thin plates, was photographed using the following experimental arrangement. Two optically flat glass plates about four inches in diameter were placed one on top of the other, the lower surface of the top plate was made semi-reflecting (semi-aluminized), the top surface of the lower plate being reflecting (fully aluminized). The scattering points were scratches on the semi-aluminized surface, or were simply produced by spreading a thin smear of oil over the surface with the finger. The flats were placed on the table and illuminated by a mercury lamp. The light from the source passed through a narrow slit (about 2 mm. wide) in a large black card, the plates being arranged so that the scratched lines were normal to the direction of the light. They were observed at an angle of 45° to the normal and two sets of interference patterns were visible. One set was localized in the plane of the surface of the half-aluminized plate, whereas the other pattern was localized in a curved surface close to the scattering surface. This latter pattern corresponds to the position of the Newton ring pattern formed by multiple reflexions as given by Feussner[3] and discussed by Tolansky[4]. It is suggested that the two fringe patterns are produced in the manner shown in Fig. 1*a* and 1*b*. The system of fringes indicated by Fig. 1*a* is localized in the scattering surface *C*, whereas the system corresponding to Fig. 1*b* for perfectly flat and parallel plates would be at an infinite distance. For the first set

$$(n_1 + \tfrac{1}{2})\lambda = 2d \cos \theta ; \quad . \quad . \quad . \quad (1)$$

and for the second set

$$(n_2 + \tfrac{1}{2})\lambda = 2d \cos \varphi. \quad . \quad . \quad . \quad (2)$$

The interference pattern corresponding to the colours of thick plates is given by the summation of these two patterns, whence

$$(n_1 - n_2)\lambda = 2d (\cos \theta - \cos \varphi) \quad . \quad (3)$$

Owing to the different locations of the two sets of fringes, it is difficult to photograph them together. Fig. 2 gives the general effect of the combination of the two patterns. The plates had been tilted so as to form a wedge angle, the two sets being then approximately straight lines inclined at slightly different angles. The intersection of these systems is clearly seen as bright and dark bands running across the photograph.

The above interpretation may be confirmed by holding a frosted plate in front of the two plates, when the pattern corresponding to the second system is seen. If the frosted plate is placed between the observer and the plates, a pattern similar to the first system is observed. These two patterns are usually distinctly different; for example, in one case a single interference colour pattern covered the diameter of the plate, and in the other the pattern consisted of several lines.

When the mercury lamp was replaced by a white-light source, the double system of fringes could not be distinguished; but a single system occurred which corresponded in position to the intersection of the two systems. This pattern corresponds to the pattern previously studied under the title of the colours of thick plates, and it is suggested that it is produced by the summation of the pair of interference patterns of the simpler Newton ring type.

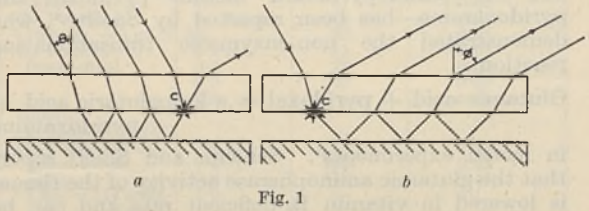

Fig. 1

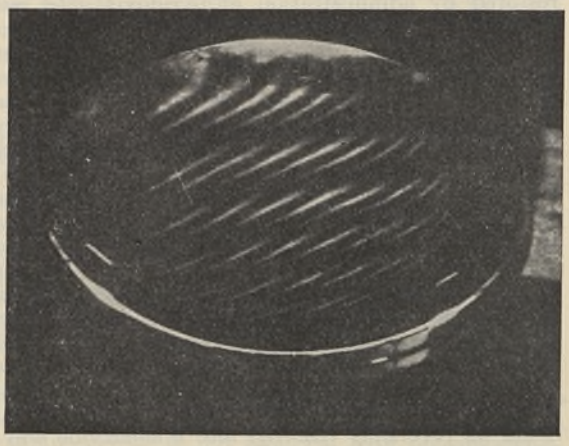

Fig. 2

In order to account for the colours of thick plates, Stokes came to the conclusion that it was necessary for two rays to be scattered from the same scattering element. He reached this conclusion as he was unable to observe the coloured pattern when he viewed a luminous point through a plate of glass, both surfaces of which possessed scattering centres. The alternative theory suggests that the colours are not produced by the diffraction effects at the scattering centres but by interference effects produced by reflexions between the plates, the scattering centres acting as secondary sources of light. The comparative faintness of the transmission pattern corresponding to the reflected pattern can be explained as follows. Since neither surface contained a reflecting layer, the intensity of the double set of interference patterns would be low and the resulting interference pattern difficult to see. These two patterns would be produced in a manner similar to that of transmission Newton ring patterns for thin plates. For glass surfaces that have not been made semi-reflecting these do not have the contrast of reflected interference patterns. The single-coloured pattern produced by a strong white light source can be readily observed, as was pointed out by Bauchwitz and Shoenberg, if the surfaces are heavily silvered. They may also be faintly observed on viewing a distant lamp through a glass plate one or both surfaces of which carries light scratches.

Further details of the experiments carried out were read last year to the Royal Society of Victoria[5] and are being published by that body.

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University of Melbourne.
May 28.

[1] Bauchwitz, F. K., and Shoenberg, D., *Nature*, **156**, 142 (1945).
[2] Stokes, G., *Trans. Camb. Phil. Soc.*, **9**, 147 (1851).
[3] Feussner, Gehrcke, "Handbuch der Physik: Optik", **1** (1927).
[4] Tolansky, S., *Phil. Mag.*, vii, **35**, 120 (1944).
[5] Hopper, V. D., *Proc. Roy. Soc. Vic.*, **58**, Part 2, Art. (1946).

CO-AMINOPHERASE, CO-DECARBOXYLASE AND PYRIDOXAL

ASPARTIC aminopherase from skeletal or heart muscle is readily dissociable and catalyses the transamination between *l*-aspartic and pyruvic acids in the presence of a dialysable co-enzyme[1]. Concentrates of this co-aminopherase have been prepared from pig heart by us and the substance has been shown to be acid-labile[2]. Glutamic aminopherase is not inactivated by dialysis. Attempts of Cohen[3] and Lènard and Straub to activate this enzyme with thermostable factors are based upon misinterpretation of the suggestion that glutamic aminopherase might contain a difficultly dissociable prosthetic group similar to co-aspartic-aminopherase[1].

Suggestive evidence pointing to a possible relationship between the prosthetic group of aminopherase and the 'pseudopyridoxin' factors—pyridoxal and pyridoxamine—has been reported by Snell[4,5,6], who demonstrated the non-enzymatic transamination reaction :

Glutamic acid + pyridoxal = α-ketoglutaric acid + pyridoxamine

in model experiments[5]. Schlenk and Snell[6] report that the glutamic aminopherase activity of the tissues is lowered in vitamin B_6-deficient rats and can be restored by administration of pyridoxin. *In vitro* reactivation of glutamic aminopherase by the addition of pyridoxal in the presence of adenosinetriphosphate was slight and irregular. Gunsalus, Bellamy and Umbreit[7] and Baddiley and Gale[8] have shown that the coenzyme of the bacterial amino-acid decarboxylases[9] is replaceable by, and probably identical with, phosphorylated pyridoxal. Cohen and Lichstein[10] found no significant decrease in the transaminase activity (glutamic→aspartic) of *S. fæcalis* R. grown in pyridoxin-deficient media ; but Lichstein, Gunsalus and Umbreit[11] repeated the work under more exacting conditions and showed that such organisms have in fact markedly decreased transaminase activity, which can be restored to normal by the addition of pyridoxal phosphate to the washed suspensions. These workers also obtained a cell-free preparation containing active transaminase from *S. fæcalis* and showed that it could be reversibly resolved into apo-enzyme and a co-enzyme moiety which could be replaced by pyridoxal phosphate. Green, Leloir and Nocito[12] obtained a purified preparation of transaminase from pig heart and, although they were unable to resolve the enzyme, showed that boiled preparations can replace the coenzyme portion of 'dopa' decarboxylase which can be replaced, in turn, by pyridoxal phosphate or Gale's codecarboxylase[9].

With the view of elucidating the mutual relations between phosphopyridoxal and the coenzymes of transamination and of amino-acid decarboxylases, we made an arrangement with Dr. E. F. Gale of Cambridge to perform comparative assays of the two coenzymes and of pyridoxal phosphate with the respective apo-enzymes and substrates. In this note we report the results of preliminary assays of the activity towards apo-aspartic-aminopherase in the transamination reaction *l*-aspartic acid→*l*-alanine with the following co-factors (Table 1) :

A. Co - aspartic - aminopherase concentrate[2] ; 0·02 ml. corresponds to 1 gm. pig heart muscle.

B. Lead salt of concentrate of natural codecarboxylase, kindly supplied by Dr. Gale, who states that 1 mgm. of lead salt is equivalent to 6 μgm. of barium-pyridoxal-phosphate when assayed against tyrosine apo-decarboxylase.

C. Synthetic pyridoxal phosphate as its barium salt, prepared by Gunsalus *et al.*[13] and obtained from Prof. Gunsalus through Dr. Gale. The preparation contains little impurity and 32 per cent pyridoxal[13].

D. Preparation *A* was subjected to extraction with phenol and the extracted material precipitated as a lead salt, 1 mgm. being equivalent to 0·025 ml. concentrate *A*. This procedure follows steps in the purification of codecarboxylase[9].

E. Boiled solutions of highly purified glutamic aminopherase prepared according to Lènard and Straub[14] ; 1 mgm. of the enzyme formed 18 mgm. pyruvic acid from alanine and ketoglutarate in 15 min. which corresponds to 18 Lènard–Straub units. Dr. Gale kindly informed us that 6 mgm. of this boiled enzyme were equivalent to 0·6 μgm. of barium-pyridoxal phosphate (*C*) in the tyrosine decarboxylase test and to 0·37 μgm. pyridoxin in a microbiological assay effected by Dr. M. Chance of Glaxo Laboratories.

F. Pyridoxal hydrochloride (courtesy of Dr. E. E. Snell) in the presence of adenosine-triphosphate and pig-heart press-juice activated by autolysis at 0° and dialysed[1].

TABLE 1

TEST SAMPLES CONTAINED IN A TOTAL VOLUME OF 6 ML., 4 ML. APO-ASPARTIC-AMINOPHERASE, 200 μMOL. *l*-ASPARTIC ACID, 200 μMOL. PYRUVIC ACID, PHOSPHATE BUFFER *p*H 7·4 AND COFACTORS AS INDICATED BELOW. SAMPLES WERE INCUBATED AT 37° FOR 1½ HR. AND ANALYSED FOR ALANINE BY THE METHOD OF FROMAGEOT AND HEITZ[15]

Exp. No.	Alanine formed in control without cofactors (μmol./sample)	Alanine formed in excess of control (μmol./sample) in presence of :										
		ml. co-aminopherase *A*				mgm. codecarboxylase *B*						
		0·01	0·02	0·04	0·06	0·2	0·4	0·5	0·6	0·8	1·0	
1	0	38	46	50	—	12	—	14·6	—	37	54·5	
2	13	38	37	78	—	5	—	7	28	36	46	
3	0	28	30	44	52	—	—	28	—	—	—	
4	25	—	—	—	—	10	36	50	30	28	15	
						μgm. phosphopyridoxal *C*						
						5	10	20	20 (no pyruvate)			
5	36	—	25	54	65	0	8	10	0			
6	15	3	40	50	—	5	10	15				
		Boiled glutamic aminopherase *E* 108 units equivalent to 6 mgm.				co-aminopherase extract *D*						
						1 mgm.			2 mgm.			
7	20	0				0			7			
8	0	0				—			5			

It can be seen from Table 1 that the partially purified natural codecarboxylase (*B*) is fairly active in the aspartic-aminopherase system, 1 mgm. of the lead salt being approximately equivalent to 0·02–0·04 ml. of co-aspartic-aminopherase concentrate *A*. In contrast to this, comparatively large amounts of phosphopyridoxal or of co-aminopherase *A* after extraction with phenol and lead precipitation (*D*) show only slight doubtful activity. Boiled glutamic aminopherase is inactive as cofactor. A similarly low degree of activation was obtained in dialysed heart press-juice with either phosphopyridoxal or pyridoxal plus adenosine triphosphate (Table 2).

From our results it would appear that the coenzyme system of mammalian aspartic aminopherase is either different from, or more complex than, phosphopyridoxal. The system is present in the codecarboxylase preparation. In attempts to supplement co-aspartic-aminopherase after inactivation by 20 min. boiling with 0·1 *N* sulphuric acid, by the addition of

TABLE 2. EXPERIMENTS WITH DIALYSED HEART JUICE

Exp. No.	Alanine formed in control without co-factors (μmol.)	Alanine formed in excess of control (μmol.) in presence of: 100 μgm. pyridoxal + 2·5mgm. ATP	20μgm.(C) phospho-pyridoxal	Co-aspartic-amino-pherase	Inactivated co-aspartic-aminopherase + alone	Inactivated co-aspartic-aminopherase + 20μgm.C
9	25	10 10·2	14	55	14	28
10	25	11 12	5	46	5·4	12

phosphopyridoxal, we obtained only a simple additivity of the small activation increments due to the separate cofactors (Table 2).

The experiments are being continued.

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ARRANGEMENTS were made with Prof. Braunstein, as indicated in his letter above, to carry out comparative assays of codecarboxylase, coaminopherase and barium-phosphopyridoxal preparations against aspartic-aminopherase on one hand and tyrosine decarboxylase on the other. For assay of tyrosine codecarboxylase activity, tyrosine decarboxylase was prepared from *S. fæcalis* cells and the apo-enzyme made by precipitation with ammoniacal ammonium sulphate solution followed by standing at 0° as described by Epps[16]. We are indebted to Prof. I. C. Gunsalus for a sample of highly purified synthetic barium-phosphopyridoxal[13], and a standard curve was obtained relating the activity of the tyrosine enzyme to the concentration of phosphopyridoxal. An amount of apo-enzyme preparation was chosen which would give 220 μl. carbon dioxide from tyrosine in 5 min. at 30° and *p*H 5·5 when saturated with coenzyme; the corresponding value in the absence of added coenzyme was 4 μl./5 min. and the rate of carbon dioxide evolution bears a linear relation to phosphopyridoxal concentration for quantities of the latter up to 0·4 μgm. barium salt per 3 ml. (≡ 140 μl. carbon dioxide per 5 min.). For assay purposes amounts of the various cofactors were taken which would give rise to carbon dioxide evolution under the standard conditions of not more than 140 μl./5 min. and the equivalence of barium-phosphopyridoxal read off directly from the standard curve.

Table 3 gives some of the results obtained. A lead salt of natural codecarboxylase concentrate was prepared as previously described[9]; 1 mgm. proved to be equivalent to 6·0 μgm. barium-phosphopyridoxal. In this case comparative assays were also carried out using lysine apo-decarboxylase[17] when 1 mgm. of lead salt proved equivalent to 5·3 μgm. barium-phosphopyridoxal. Co-aspartic-aminopherase was received from Prof. Braunstein as three preparations. *A*(*a*) was a solution of the concentrate[2], *A*(*b*) a dry lead salt prepared from *A*(*a*) after extraction into phenol, and *A*(*c*) a freeze-dried preparation of *A*(*a*). The solution *A*(*a*) had very little activity in the tyrosine decarboxylase system; this little activity seemed to have survived in the lead-salt *A*(*b*), but 1 ml. of the co-aminopherase concentrate proved to be equivalent to 0·05 μgm. barium-phosphopyridoxal only. It is possible that these preparations had suffered some deterioration, as the freeze-dried preparation

TABLE 3. TYROSINE CODECARBOXYLASE ACTIVITIES OF PREPARATIONS WARBURG FLASKS CONTAIN 1·5 ML. *M*/5 CITRATE-PHOSPHATE BUFFER *p*H 5·5, 0·3 ML. TYROSINE APO-DECARBOXYLASE PREPARATION, CO-ENZYME PREPARATION AND/OR WATER TO TOTAL VOLUME 2·5 ML. SIDE-BULBS CONTAIN 0·5 ML. *M*/15 *l*-TYROSINE SUSPENSION, TIPPED AFTER 15 MIN. EQUILIBRATION. CARBON DIOXIDE EVOLUTION MEASURED AT 30° C.

Preparation	Quantity	μl.CO_2/ 5 min.	Equivalence of barium phosphopyridoxal (μgm.)
Ba-phospho-pyridoxal (*C*)	None	4	
	0·1 μgm.	37	
	0·2	68	
	0·3	106	
	0·4	150	
	0·6	179	
	1·2	216	
	3·0	220	
Pb-salt of codecarboxylase (*B*)	0·01 mgm.	24	0·06
	0·03	60	0·18
	0·05	96	0·28
	0·1	188	0·62
	1·0	—	6·0
Co-aspartic-aminopherase	0·2 ml.	11	0·02
(*a*) solution *A*	0·5	11	0·02
(*b*) Pb-salt *D*	5 mgm.	11	0·02
10 mgm. = 1 ml. *A*	10	22	0·05
(*c*) Prep. *A*	0·1 ml.	11	0·02
freeze-dried	0·3	22	0·05
	0·5	32	0·09
	1·0	—	0·18
Glutamic aminopherase (*E*)			
(*a*) Freeze-dried;	0·1 ml.	75	0·21
boiled before	0·2	122	0·35
assay.	0·3	142	0·42
1 ml. = 117 units = 6 mgm.	1·0	—	2·1
(*b*) Boiled at	0·5 ml.	116	0·33
*p*H 7 before	0·5	110	0·315
freeze-dried	1·0	—	0·65
1 ml. = 108 units = 6 mgm.			

A(*c*) gave an equivalence of 0·18 μgm. barium-phosphopyridoxal/ml.

From the results shown above in Prof. Braunstein's communication, it can be seen that 1 ml. of coaminopherase concentrate *A* is equivalent to approximately 2,000 μgm. barium-phosphopyridoxal in the aspartic-aminopherase system. Further, although codecarboxylase (*B*) is active in the aspartic-aminopherase system, it has there an equivalence of 0·02–0·03 ml. co-aspartic-aminopherase (*A*) per mgm. compared with an equivalence of approximately 30 ml. co-aspartic aminopherase per mgm. assayed in the tyrosine decarboxylase system. These results indicate that coaminopherase is not identical with phosphopyridoxal although the natural codecarboxylase concentrate possesses some coaminopherase activity.

Glutamic aminopherase. Preparations of glutamic aminopherase were received from Prof. Braunstein in two forms: *E*(*a*) consisted of a preparation containing 117 Lenard–Straub transaminase units per ml.; this had been freeze-dried in the active state. Prof. Braunstein states that the activity after drying had fallen to 70 units per ml. The preparations had not been dialysed and contained ammonium sulphate, but the activity indicated a protein content of about 6 mgm./ml. Before assay in the tyrosine decarboxylase system, the contents of each ampoule (= 1 ml. original preparation) were dissolved in 1·0 ml. of *N*/100 caustic soda and boiled for 5 min. to liberate codecarboxylase[9]. Assays were carried out on the complete boiled material after neutralization to *p*H 5·5. The material was markedly active as codecarboxylase, 1 ml. of *E*(*a*) having an equivalence of 2·1 μgm. barium-phosphopyridoxal. In further samples, the enzyme preparation had been dialysed and 1 ml. samples (= 6 mgm. enzyme) boiled at *p*H 7 before freeze-drying. For assay these samples were

dissolved in water and tested directly; 1 ml. of this preparation had an equivalence of 0·65 μgm. barium-phosphopyridoxal. Other samples which had been boiled at *p*H 4 or 8 showed further deterioration.

Green, Leloir and Nocito[12] prepared two transaminating enzymes from pig heart, one carrying out a transamination from glutamic acid to α-ketoglutaric and the other from glutamic acid to pyruvic acid. This second enzyme is presumably the same as glutamic aminopherase of Braunstein. Green *et al.* found that the pure enzyme contained codecarboxylase as a constituent of the preparation, and it can be calculated from the figures in their paper that 1 mgm. of the purest enzyme preparation contained 0·269 gm. phosphopyridoxal when assayed against 'dopa' decarboxylase. Prof. Braunstein stated in a letter to us that the transamination *Q* of his preparation was approximately 18,000 compared with an activity of 29,000 for the highest attainable purity according to Lènard and Straub. Consequently the assay value of 0·18 μgm. phosphopyridoxal per mgm. enzyme (*Ea* Table 3) compares very well with that obtained by Green *et al.*

We are indebted to members of the Science Department of the British Council for arranging the transfer of material between Cambridge and Moscow.

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Reversible Splitting of Glutamic Aminopherase

Two enzyme systems catalysing the transamination of amino-acids have been prepared from muscle and heart tissue and described by one of us (M.K.)[1,2]. These enzymes were termed glutamic aminopherase and aspartic aminopherase, according to their specific primary substrates[3]. The latter is easily inactivated in the initial stages of purification (dialysis, etc.), and can be reactivated by a thermostable coenzyme present in boiled tissue extracts[4]; while the former can be prepared from muscle tissue without loss of activity.

In a preliminary note[5] it was suggested that glutamic aminopherase might contain a prosthetic group less readily dissociable than that of aspartic aminopherase. Recently we obtained experimental data indicating that glutamic aminopherase prepared by the method of Lènard and Straub[6] (stage *B*) can be inactivated reversibly by acidification to about *p*H 2·8 or alkalization (in a broad range near *p*H 10–11), followed by dialysis. Part of the enzyme is inactivated irreversibly, depending upon the degree of acidity or alkalinity. The inactivated enzyme (= apo-enzyme) can be reactivated to some extent by the addition of boiled muscle (or liver) extract. The degree of reactivation ranges from 20 to 70 per cent, as shown in the accompanying table, averaging 37 per cent, and 30 per cent upon acid- and alkaline-splitting respectively.

Decrease or formation of pyruvate[6] in μmol. per ml. enzyme (about 100 Lenard–Straub units).
Composition of test samples and experimental conditions were the same as in aminopherase activity determinations according to Lenard–Straub[6]. Enzyme prepared Jan. 4, 1946.

Date of experiment	Initial amount of pyruvate or α-keto-glutarate	Disappearance or formation of pyruvate in 15 minutes (μ-mol.)			
		Activity of untreated enzyme	Residual activity of tested apo-enzyme	Additional activity with boiled tissue extract	Reactivation %
Split by acidification (*p*H 2·8)					
	Pyruvate				
8·1	300	78	0	26	33
16·1	307	101	0	28	27
19·1	388	129	0	44	34
23·1	311	117	0	81	70
	α-keto-glutarate				
25·1	259	98	0	26	26
29·1	269	196	0	75	38
Split by alkalization (*p*H 10–11)					
16·111	320	113	85	33	28
18·111	,,	88	74	32	43
,,	,,	88	74	17	20

In some experiments prolonged dialysis against distilled water or buffer solutions of different *p*H also resulted in partially reversible inactivation of the enzyme.

Negative results were obtained in attempts to reactivate apo-glutamic aminopherase by the addition of co-aspartic aminopherase concentrate, co-decarboxylase or phosphopyridoxal[4], and by flavine-adenine-dinucleotide or thiamine.

The nature of the active group of glutamic aminopherase is under investigation.

Addendum by cable received May 25. We have reported above on the reversible splitting of glutamic aminopherase prepared according to Lènard–Straub, stage *B*; tissue Kochsaft reactivated the apo-enzyme. Further investigation showed that a purer preparation of this enzyme (Lènard's stage *D*) is split more readily upon acidification and dialysis. Reactivation can be effected by addition of Kochsaft or of 1–5 μgm. phosphopyridoxal. Larger quantities, 10–25 μgm., phosphopyridoxal fail to activate the enzyme. Our negative results with phosphopyridoxal were due to the inhibitory action of the excessive concentrations employed.

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RECENT LOW-TEMPERATURE RESEARCH AT THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

THE fourth meeting of the Low Temperature Group of the Physical Society was held on May 15 in the Department of Chemical Engineering and Applied Chemistry, Imperial College, when the work of the Department in the field of low-temperature technology was described and the laboratories and equipment were open to inspection by members of the Group. The head of the Department, Sir Alfred Egerton (who is also chairman of the Low Temperature Group), describing the origin of his interest in low-temperature technology, said that in a country where petrol is not indigenous, as much use as possible should be made of the hydrocarbon methane, which can be made available in unlimited quantities from coal. One use that is feasible is as a fuel for internal combustion engines. The best way to carry methane on motor-vehicles is as a liquid in vacuum-jacketed tanks, at approximately atmospheric pressure and normal boiling point, −161·4° C.

During the War a variety of problems connected with this subject were attacked and solved, to the point where it would have been possible, if required, to produce cheap liquid methane on a large scale and to provide motor-vehicles with reliable equipment which would permit the use of either petrol or liquid methane, according to which was available. The cost of liquid methane from coal gases would not be so low as that of petrol, but it could be competitive with other liquid fuels produced from coal. In some countries where natural gas or waste vegetation are sources of methane, the liquid could be produced at quite a low cost.

The work at the Imperial College included the design and construction of a pilot methane liquefier and a liquid methane rectifying-column, the design of vacuum-jacketed vehicle tanks and of equipment for feeding the liquid to the engine, and tests on engine performance and wear. In addition, numerous laboratory investigations were carried out on the vapour-liquid phase equilibria of mixtures containing methane; the heat transfer coefficients of methane and other gases under forced convection at low temperatures; the measurement of thermal conductivities of insulating materials at low temperatures; the measurement of heat radiation from various metal surfaces from the point of view of their incorporation in vacuum-jacketed vessels; the solubilities in water of methane, carbon dioxide, and their mixtures under pressure, and the fire-hazards attendant upon the use of liquid methane on vehicles.

With the end of the War and the end of restrictions on the Department's activities, the scope of the work was extended. A laboratory liquid-air plant utilizing Freon-12 as a pre-cooling fluid has been designed and is now being constructed. A method of purifying gases from small quantities of condensable constituents by the injection of a stream of cold pure gas is being tried out, and experiments are in progress to determine the factors influencing the adhesion of frozen particles to tube walls. Both these investigations derive from the general problem of the purification of industrial gases prior to liquefaction. An apparatus has been constructed for the determination of the latent heat of vaporization of binary mixtures at low temperatures and pressures above atmospheric; and an investigation is in progress on the properties of lubricants at low temperatures.

Calculations and experiments have been made on the extraction by refrigeration of olefines and methane from coal or coke-oven gases, the first being of use in chemical synthesis, the second in the form of liquid, as a thermal reservoir to meet peak loads on town-gas undertakings. The methane would be extracted and stored as liquid at periods of low demand, and re-gasified to enrich water gas at periods of high demand.

The experimental work of the Department was exhibited to the Low Temperature Group, and the various activities were discussed in greater detail in the course of short addresses given by Sir Alfred Egerton, Prof. D. M. Newitt, Mr. M. Pearce and Dr. T. A. Hall, on the storage of liquefied gases, on the unexplored regions of the temperature-entropy diagram, and on the purification and separation of constituents of coal and coke-oven gas by liquefaction.

IMPORTANCE OF TAXONOMY

IN the course of his final presidential address to the Linnean Society on May 24, Mr. A. D. Cotton took occasion to emphasize the importance of taxonomy and the need of securing additional workers in this branch of biology.

Speaking of the distribution of the Dendrosenecios on the equatorial mountains of Africa, he said it was the impossibility of reconciling the records of the species on Kilimanjaro and on other mountains which led him to take up the study of the group. Many records existed in systematic literature; and ecologists and others used these records for their field work and in their published papers. When he came to study them he was confronted by a state of affairs only too familiar to all experienced taxonomists. Except where new species are concerned, no record, whether in floristic or ecological literature, could be accepted at its face value. This casts no reflexion on the botanists of the past. The fact illustrates the slow growth and evolution of a difficult branch of botanical science and demonstrates the imperative need for further taxonomic research and of a more intensive type.

Mr. Cotton does not maintain that the classification he has prepared is perfect or final, because much more field work is necessary; but with the aid of as much co-operation as possible in the field and by examination of all herbarium material extant, it is believed to be reasonably correct.

The Linnean Society is the one Society which, from its inception to this day, has cared for general taxonomy, and at the present time, when the subject tends to be overshadowed by other branches of biology, the Linnean Society has never shrunk from bearing the very heavy expense of publication of systematic papers even to the serious depletion of its funds. Systematic papers are not usually suitable for reading at meetings but are prepared for use and for reference. They have a permanent value not often attained by other papers. The Society aims at being broad in its interests, but one of its principal functions is the publication of such papers for the benefit of botanists and zoologists throughout the world. Taxonomic work and its publication is, in fact, in large measure, essentially a service.

There is no doubt that the standard of taxonomy needs to be raised aloft. Looking back over a period of twenty years, during which he has been in charge of a great systematic institution, Mr. Cotton has become acutely conscious of the need of recruits to this branch of biology. Unless such recruits be forthcoming, and in considerable numbers, the immense floras and faunas of the world can never be properly understood. Only those who have worked with such world floras and faunas have any conception of their magnitude and their riches in genera and species.

Ecology and cytology naturally make a strong appeal also to the present-day student not only on account of their intrinsic interest but also because of their suitability for short-term research and research theses: but their very interest and glamour is apt to lead to the less exciting, more exacting, but all-important work of taxonomy being passed by. It may even fall into disrepute among those who do not realize the value of taxonomy, or who think only in terms of nineteenth-century systematics. Mr. Cotton therefore appealed to the young biologist to consider seriously the claims of this branch of science. There can be no question of the need for a greater number of professional taxonomists. The flora or handbook which the ecologist or economic botanist demands when he takes up a Colonial appointment can only be prepared after years of patient labour in a systematic institution, while more fortunate colleagues who carry out researches on such subjects as physiology and genetics require correctly named material or they may find their results at variance with those of other workers.

Mr. Cotton pointed out that this emphasis on the importance of taxonomy was not made on account of personal preference but from a sense of responsibility and a desire to serve the interests of biologists as a whole.

METHODS AND RESULTS OF NUTRITION SURVEYS

IN October 1944, the Nutrition Society set up a Standing Advisory Committee "for co-ordination of methods of survey in liberated territories". Advantage was taken of the fact that there was in Britain at that time a large number of scientific workers from enemy-occupied countries, and three representative panels were set up to report on: (1) laboratory methods; (2) clinical methods; (3) methods of survey of food consumption.

Certainly some agreement on terminology, methods of investigation and ways of presenting results is badly needed, particularly for the first two. As things stand, it is difficult to compare one person's findings with another's, with any assurance that the measurements made do, in fact, provide a true basis for comparison.

Two of the three panels (the first and the third) presented reports in August 1945*. It would be very valuable if the Nutrition Society would now add a short note on the experiences since gained by investigators while putting the recommendations into practice. Has any modification been required, and if so, what? Have any other techniques been evolved or found more practicable?

Choice of method for any investigation is inevitably limited by the facilities available. The Laboratory Methods Panel has recognized this and has limited its recommendations accordingly. Estimations of hæmoglobin and of proteins in plasma or serum are dealt with very fully, and tests of vitamin C status are described; but comment on "the assessment of level of nutrition with regard to B-vitamins" is limited to a short description of the principles and relevant literature, since "the biochemical evaluation of the nutritional status of the B-vitamins requires elaborate equipment and special chemicals".

It appears that the main difficulties in reaching any uniformity of meaning in past surveys have been due to: (1) differences in methods used; (2) differences in assumptions on which calculations were based; (3) differences in standards used; (4) personal factors; (5) errors in instruments; (6) differences in methods of expressing results.

Accordingly, among the recommendations made, the Panel suggests: (1) that apparatus used should be standardized; (2) that results should be expressed in absolute units and in the decimal system; (3) that methods in which subjective errors may be large should be avoided.

In addition to critical reviews of estimation methods mentioned above, there are "general recommendations with regard to taking samples of blood" and a detailed table putting together the results of a very large number of surveys dealing with hæmoglobin-levels, all of which had been conducted under conditions meeting with the requirements of the Panel. Other tables set out results of surveys showing protein levels in serum or plasma in healthy persons and under conditions of nutritional œdema.

The report ends with details of working methods and a "comparison of results obtained by various methods with those obtained by measurement with other methods used as standards". A list of references is included.

The Food Consumption Panel had a problem of a different nature to face. Provided facilities are available, laboratory investigators have a straightforward job; but dietary surveys are always complicated by the fact that collection of data for analysis depends to a very large extent on obtaining full co-operation from the individuals being surveyed. At the best of times this is difficult to ensure; under the unsettled conditions immediately following liberation of enemy-occupied countries, it must have been still more difficult. Where there are food shortages and the inevitable 'black market', investigators must necessarily be regarded with suspicion, if not with fear. In territories where the administration is in the hands of strangers, the local population is usually inclined to blame them for all difficulties and shortages, and investigators belonging to such an administration may find it virtually impossible to establish the necessary confidence.

The Panel recognized that such difficulties would exist, and it is stated that "investigators should be provided with letters of authority and preferably with a photograph. Arrangements should be made with the local burgomaster and police to establish the credentials of each investigator and ensure her protection if necessary." It would be interesting to know how this has worked out in practice; my own experience is that the more informal and unofficial

* Standing Advisory Committee for Co-ordination of Methods of Survey in Liberated Territories. Recommendations with Regard to Methods of Investigation of Nutrition. Pp. 67. Dietary Panel: Methods for Dietary Survey. Pp. 23. (London: Bureau of Nutrition Surveys, London Hospital, E.1, 1945.)

the contact between investigator and investigated, the more readily the information is obtained and the more complete it appears to be.

The Panel proposed that four kinds of dietary surveys should be made—"of (1) the family, (2) individuals, (3) the consumption of individual foods, and (4) institutions and works canteens". Two methods of family studies are described in detail: (*a*) a questionnaire method, and (*b*) the log-book method. The first of these is largely a test of the housewife's memory (in addition to her willingness to tell); the second requires her to keep detailed records, with the investigator checking every second day following the initial recording of stores. For individual intake records, a measurement-at-table technique is described.

These methods were used successfully in Britain even during the War, but conditions in newly liberated territories must surely have been very different. The Panel goes on to state that "it is important that sufficient clerical staff is available to keep the analyses of the data well in hand", it suggests that "each household might be surveyed for at least a fortnight and whenever practicable for four weeks", and it talks of a "team of thirty to forty investigators together with four supervisors", and the establishment of a central organisation for Hollerith work analysing the survey data.

The report would, in my opinion, have gained in value if it had included a description of methods which could be applied when such facilities are not available and under conditions where form-filling co-operation cannot be expected (after all, it is not only the illiterate who find difficulty in filling in forms accurately). However, it may be that the Panel—apparently thinking in terms of Europe only—was able satisfactorily to forecast the conditions and facilities which were actually found. It would now be useful and interesting to know.

The report on "Nutrient Values of European Foodstuffs During the War", prepared by the Combined Working Party on European Food Supplies, is included as an appendix. M. W. GRANT

GLACIER OSCILLATIONS IN THE NORTHERN AND SOUTHERN HEMISPHERES

THE Report of the Committee on Glaciers for 1945 (*Trans. Amer. Geophys. Union*, 27, 219; 1946) contains much valuable data on glacier variations in the United States and Peru, together with an outline of the general pattern of glacier histories in the two hemispheres.

Prior to 1850, European glaciers had been oscillating forward and backward at frequent intervals, the major advances being the greatest since the end of the Pleistocene. Since 1850, however, recession has been dominant, although interrupted by a moderate re-advance around 1890 and by local smaller advances between 1910 and the early 1930's. The recession has proceeded by successive stages of increasing rapidity, with marked acceleration during the last decade. In the western United States recession has also been dominant since the 1850's, and although some glaciers made feeble and brief re-advances during the 1920's and early 1930's, on the whole the rate of recession has accelerated up to the present time.

The glaciers of New Zealand lost enormously in length and thickness between the 1860's, when the first observations were made, and the early 1890's, when they regained much of their volume. Small temporary re-advances have been noted during about 1906–34, but since then the glaciers have again been wasting away, at an increasing rate which has recently been quite abnormal. The Peruvian glaciers have shared an almost parallel history since the 1860's, again including a phase of accelerating shrinkage since 1932.

Thus in both hemispheres there has been dominant shrinkage during the last eighty or ninety years, with rather close synchronization of some of the variations and especially of the remarkable accelerating recession of recent years.

Among the inferences drawn from the evidence passed in review by the Committee on Glaciers, the following are of far-reaching significance:

(*a*) The causative climatic variations have affected both hemispheres simultaneously and not in alternation.

(*b*) It is therefore reasonable to suppose that the more pronounced post-Pleistocene variations and the major Pleistocene variations were also synchronous in the two hemispheres.

(*c*) Whatever the causes of these climatic variations may be, their world synchronism rules out all 'astronomical theories', such as those of Croll, Spitaler and Milankovitch, that require refrigeration of one hemisphere and simultaneous warming of the other. The mathematical verity of these theories is not impugned, but it is evident that the causes of climatic change which they postulate are subordinate to other more potent causes, the nature of which is still undetermined.

(*d*) Calculations of glacio-eustatic changes of sea-level that are based on the assumption of synchronous glaciation and synchronous deglaciation in both hemispheres are essentially sound in principle.

FORTHCOMING EVENTS

Tuesday, July 23

ROYAL ANTHROPOLOGICAL INSTITUTE (joint meeting with the SOCIETY OF ANTIQUARIES OF LONDON and the UNIVERSITY OF LONDON INSTITUTE OF ARCHÆOLOGY, at University College, Gower Street, London, W.C.1), at 5.30 p.m.—Dr. L. S. B. Leakey: "The Acheulean Site of Olorgasailie, Kenya".

Thursday, July 25

BRITISH ASSOCIATION (joint meeting of Section L (Education) and the Division for the Social and International Relations of Science, at the Royal Institute of British Architects, 66 Portland Place, London, W.1), at 10.30 a.m.—Conference on "UNESCO and Universities".

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 5 p.m.—Prof. Emmanuel de Margerie: "Three Stages in the Evolution of Alpine Geology—Saussure, Studer, Heim" (Second William Smith Lecture).

APPOINTMENTS VACANT

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

ASSISTANT LECTURER AND DEMONSTRATOR IN BOTANY, a LECTURER IN THE ELECTRICAL ENGINEERING DEPARTMENT, a LECTURER IN THE MATHEMATICS DEPARTMENT, a SENIOR LECTURER IN PRODUCTION ENGINEERING, a LECTURER IN THE NATURAL PHILOSOPHY DEPARTMENT, and DEMONSTRATORS (2) IN THE DEPARTMENT OF PHARMACY—The Secretary, Royal Technical College, Glasgow (July 27).

LECTURER IN CHEMISTRY at the Coventry Technical College—The Director of Education, Education Offices, Coventry (July 27).

JUNIOR LECTURER IN ELECTRICAL ENGINEERING—The Clerk and Treasurer, Dundee Technical College, Bell Street, Dundee (July 27).

SENIOR LECTURERS (2) IN MATHEMATICS in the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 24 Gordon Square, London, W.C.1 (July 30).

LECTURER and an ASSISTANT LECTURER IN MECHANICAL ENGINEERING—The Registrar, University College, Southampton (July 31).

LECTURER IN CHEMISTRY in the Burnley Municipal College—The Director of Education, Education Offices, Burnley (July 31).

LECTURER IN ELECTRICAL ENGINEERING—The Secretary of University Court, The University, Glasgow (July 31).

ASSISTANT LECTURER IN PHARMACOGNOSY—The Registrar, University College, Nottingham (July 31).

LECTURER IN GEOGRAPHY at the United College—The Secretary, The University, St. Andrews (July 31).

PRINCIPAL SCIENTIFIC OFFICER in the Ministry of Supply to deal with specialized aspects of research, development and design connected with Artillery and Armoured Fighting Vehicles—The Secretary, Civil Service Commission, 6 Burlington Gardens, London, W.1, quoting No. 1538 (August 1).

RESEARCH ASSISTANT IN THE DEPARTMENT OF BACTERIOLOGY—The Secretary, Hannah Dairy Research Institute, Kirkhill, Ayr (August 3).

RESEARCH ASSISTANT IN AGRICULTURAL CHEMISTRY—The Registrar, The University, Leeds (August 5).

LECTURERS IN THE DEPARTMENTS OF (*a*) BOTANY (2), Ref. G.239; (*b*) GEOGRAPHY, Ref. G.240; (*c*) GEOLOGY, Ref. G.241; (*d*) ZOOLOGY, Ref. G.242; (*e*) APPLIED MATHEMATICS, Ref. A.204; (*f*) PHYSICS, Ref. A.205, and (*g*) PURE MATHEMATICS, Ref. A.206; University of Cape Town—The Ministry of Labour and National Service, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, quoting the appropriate Ref. No. (August 8).

LECTURER (ungraded) IN THE DEPARTMENT OF BOTANY—The Registrar, The University, Liverpool (August 21).

LECTURER IN GEOGRAPHY—The Secretary, The University, Aberdeen (August 24).

UNIVERSITY READERSHIP IN THEORETICAL PHYSICS at Birkbeck College—The Academic Registrar, University of London, Senate House, W.C.1 (August 27).

ASSISTANT LECTURER IN THE DEPARTMENT OF METALLURGY—The Registrar, The University, Sheffield (August 31).

ASSISTANT LECTURER (Grade III) IN APPLIED MATHEMATICS—The Registrar, The University, Liverpool (September 1).

UNIVERSITY CHAIR OF MEDICINE at the British Post-Graduate Medical School—The Academic Registrar, University of London, Senate House, London, W.C.1 (September 3).

CHAIR OF PHYSICS at Royal Holloway College—The Academic Registrar, University of London, Senate House, London, W.C.1 (September 5).

READER IN PHARMACOLOGY AND EXPERIMENTAL PHYSIOLOGY in the Department of Physiology, Medical School, King's College—The Registrar, University Office, 23 St. Thomas' Street, Newcastle-upon-Tyne 1 (September 7).

CHAIR OF CIVIL ENGINEERING, CHAIR OF ELECTRICAL ENGINEERING and the CHAIR OF MECHANICAL ENGINEERING, in the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 24 Gordon Square, London, W.C.1 (Melbourne, September 15).

DIRECTOR, ROAD RESEARCH INSTITUTE, to be established in India—The Secretary, Council of Scientific and Industrial Research, The Mall, Delhi, India (September 30).

BEYER CHAIR OF ENGINEERING—The Registrar, The University, Manchester 13 (November 1).

LECTURER IN THE DEPARTMENT OF ANATOMY AND EMBRYOLOGY—The Secretary, University College, Gower Street, London, W.C.1.

SCIENTISTS (well qualified), with research and/or teaching and administrative experience, for the British Council Cultural Scientific Office in China—The British Council, Appointments Department, 3 Hanover Street, London, W.1.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Methods of Test for Transport Gas Producer Fuels. (British Standard 1264: 1945.) Pp. 28. (London: British Standards Institution, 1945.) 2*s*. net. [101

Recommended Methods for Polarographic and Spectrographic Analysis of High Purity Zinc and Zinc Alloys for Die Casting. (British Standard 1225: 1945.) Pp. 36. (London: British Standards Institution, 1945.) 2*s*. net. [161

Ministry of Agriculture and Fisheries. Bulletin 132: Cabbages, Brussels Sprouts and Miscellaneous Green Crops. Pp. ii + 30 + 8 plates. (London: H.M. Stationery Office, 1945.) 1*s*. net. [181

The United Nations Charter. A Commentary by David Mitrany, Gilbert Murray, G. D. H. Cole, Norman Bentwich, Rita Hinden, and the Text. (Peace Aims Pamphlet, 31.) Pp. 56. (London: National Peace Council, 1946.) 1*s*. [181

British Rubber Producers' Research Association. Publication 64: Research on Pneumatic Tyres for Farm Tractors. Report of Work carried out in 1939–40 by the Institute for Research in Agricultural Engineering, University of Oxford, for the British Rubber Producers' Research Association. Pp. 32. (London: British Rubber Producers' Research Association, 1945.) 2*s*. [181

Petroleum at War. (Reprinted from the *Petroleum Times*.) Pp. 36. (London: *Petroleum Times*, 1945.) 4*s*. [181

Ministry of Health. Nurses Salaries Committee: Mental Nurses Sub-Committee. Further Recommendations. Mental Nurses S.C. Notes, No. 5. Pp. 6. (London: H.M. Stationery Office, 1946.) 1*d*. net. [281

The Pattern of Pacific Security. A Report by a Chatham House Study Group. Pp. 73. (London and New York: Royal Institute of International Affairs, 1946.) 2*s*. 6*d*. net. [281

University of Cambridge. Annual Report of the Solar Physics Committee. Pp. 2. (Cambridge: The University, 1945.) [291

Association of Special Libraries and Information Bureaux. Report of Proceedings of the Twentieth Conference held at Portland Hall, the Polytechnic, London, W.1, September 15 and 16, 1945. Pp. 112. (London: Association of Special Libraries and Information Bureaux, 1945.) 6*s*. [291

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University of Leeds. Report of the Librarian for the Session 1944–45. Pp. 6. (Leeds: The University, 1946.) [52

City and Guilds of London Institute. Report of the Council to the Members of the Institute for the Year 1944. Pp. 49. (London: Gresham College, 1945.) [52

Other Countries

Indian Forest Leaflets. No. 56: Quality of Charcoal Produced in Indigenous Kilns. By A. C. Dey and B. S. Varma. Pp. ii + 4. 4 annas; 6*d*. No. 70: Common Latex Bearing Woody Plants of India. By K. L. Budhiraja and R. Beri. Pp. ii + 18. 6 annas. No. 72: The Vegetable Tanning Materials of India, Part 1. Survey. By R. L. Badhwar, A. C. Dey and M. V. Edwards. Pp. ii + 40. 8 annas. (Dehra Dun: Forest Research Institute, 1944.) [1912

Indian Forest Bulletin, No. 125: A Note on the Insect Borers of Bamboos and their Control. By J. C. M. Gardner. Pp. 16 + 3 plates. (Dehra Dun: Forest Research Institute, 1945.) 12 annas. [1912

South Australia: Institute of Medical and Veterinary Science. Seventh Annual Report of the Council, July 1944–June 1945. Pp. 16. (Adelaide: Institute of Medical and Veterinary Science, 1945.) [31

A Trip Through the New Building of Mellon Institute. Third edition. Pp. 20. (Pittsburgh, Pa.: Mellon Institute, 1945.) [31

Western Australia: Department of Mines. Report of the Government Geologist for the Year 1943. Pp. 32. Report of the Geological Survey for the Years 1941 and 1942. Pp. 13. (Perth: Government Printer, 1944.) [31

Food and Irrigation Problems affecting India in General and Bombay in Particular. By Rao Bahadur N. S. Joshi. Pp. 68. (Poona: The Author, 1287 Shivaji-Nagar, 1945.) [31

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