NATURE

SATURDAY, MAY 18, 1935

No. 3420 Vol. 135

CONTENTS

Editorial and Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET, LONDON, W.C.2
Telephone Number : WHITEHALL 8831
Telegraphic Address : PHUSIS, LESQUARE, LONDON

Large-Scale Research in Crop Production—Cotton*

ORGANISED research in furtherance of industry has, in proportion to the interests involved, developed more slowly for agriculture than for industrial commodities or for processing or for transportation. The work of the Empire Cotton Growing Corporation, one of the youngest and now one of the strongest organisations for research on crop production, is, however, an example of bold development. The raw cotton position just after the War, when Great Britain was dependent on the United States for a very high proportion of her supplies, led to the founding of the Corporation in 1921. Production in the newer Empire fields (that is, excluding India) has since then increased from 30,000 to 90,000 tons. The financial support of the Corporation has come largely from the cotton spinning industry which, by promotion of research throughout its own grave depression, has shown striking faith in science. In brief, it is the object of the Corporation "to put the Empire into such a position that it can and will produce, within economic limits, its proper share of the cotton required by the world. . . ."

This main objective is easily seen to resolve into a great array of problems. Where cotton is a more or less familiar crop, increase of yield and improvement of quality bring up difficult questions of disease, of soil fertility, and in some cases of irrigation. But a great increase in the Empire's cotton area is clearly indispensable, and is only possible by extension to territories where cotton has not been grown at all or only scrappily, for simple local use. Here are added to the problems of established cotton areas many new, intriguing issues. Suitable varieties must be found or made. Labour must not only be trained but also, if possible, made more effective by displacing hand tools—for the available new areas are largely in East and West Africa—by cattle-drawn ploughs and hoes. In devising appropriate systems of cropping and cultivation for the new areas lie some of the most important problems. Ancient systems, resting on some form of 'shifting' cultivation, do not readily admit a wholly new crop, and that a cash crop, on any extensive scale. Further, the terrible menace of soil erosion hangs over orthodox weed-free methods in many places, while maintenance of

* Empire Cotton Growing Corporation. A Review of the Work of the Experiment Stations, Season 1933–34. By Dr. J. C. Willis. Pp. 38. (London : Empire Cotton Growing Corporation, 1935.) 1*s*. 6*d*.

fertility is a problem of which green manuring, an old, unsolved question of the most progressive European countries, is but a part. There are, too, considerable issues in ensuring supplies of seed, in grading, marketing and transport.

The Corporation has provided for the study of its problems by setting up stations, twelve in number, which besides working independently, collaborate with the agricultural departments of their territories. A post-graduate scholarship scheme has been used to provide a large part of the scientific personnel.

This great research organisation is governed by the Director of the Corporation, with advice from a small scientific committee, which meets in London. Stations have substantial freedom in determining, appropriately to their circumstances, the balance between primarily scientific and more empirical and immediate investigation. A purely scientific research station in Trinidad (not included in the "Review") is maintained for studies in which central effort and the most specialised resources are required.

Suitable collaboration and mutual assistance among twelve widely dispersed and variably circumstanced stations demand—perhaps it is the chief need—a most careful provision for interchange of views and experimental results. A volume of progress reports is issued every year by the Corporation, but this leaves unsatisfied the needs of a great number who, as contributors to the research fund, or as investigators, or as administrators in the territories concerned, are deeply interested in the realisation of the Corporation's aims. It is for them Dr. Willis's review, with its admirable brevity and simplicity, is issued.

It is natural to find plant breeding the most prominent part of the stations' work, for in new circumstances improved varieties frequently offer the earliest opportunity for agricultural progress. A selection made by F. R. Parnell, of the Corporation's staff in South Africa, has, under the name of 'U. 4', now become famous. Its great value arises from its strong, inherent resistance to the jassid (*Empoasca facialis*), an insect which formerly threatened to inhibit cotton cultivation over most of the southern half of the African continent.

Dr. Willis, in dealing with improvements in agricultural practice, refers to the importance of "work which has a definite bearing, not upon cotton as cotton, but on its satisfactory, efficient, and economical insertion into the general agriculture of the country". This obviously right, though far from common, attitude in research on a single crop, gives to the agricultural studies of the various stations an admirable range and soundness. The actual problems are as diverse as the countries in which they occur—Australia, Rhodesia, South Africa, Fiji, Sudan, the West Indies, and many parts of East and West Africa. The Corporation may be assured that an annual review in the form and the style Dr. Willis adopts in this first essay will be widely appreciated.

Reviews

Evolutionary Morphology of Plants

Primitive Land Plants, also known as the Archegoniatæ. By Prof. F. O. Bower. Pp. xiv+658. (London : Macmillan and Co., Ltd., 1935.) 30*s.* net.

THE publication of a new work by Prof. F. O. Bower dealing with the Archegoniatæ is an event of importance in the study of the morphology of plants. For Prof. Bower, who has contributed largely to our detailed knowledge by his investigations, has never rested content with mere description. He has always aimed at bringing the facts under general conceptions or hypotheses. His work has thus never lost the impulse of the evolutionary point of view, whether it has been a direct quest for phyletic lines or, as he here puts it, an attempt "to visualise the Methods of Advance which these primitive Land-Plants appear to have followed in their evolution". That he has retained this aim and the faith that it may be reached is closely connected with his work having been concerned with the Vascular Cryptogams or Pteridophyta, for these present exceptionally favourable material for evolutionary morphology. They can be studied apart from the later evolved Gymnosperms and Angiosperms, they are represented by varied living forms and they have a wonderfully good and instructive fossil record.

The Vascular Cryptogams are here considered in relation to the Bryophyta, as was the case in "The Origin of a Land Flora", published twenty-seven years ago. The subject matter is the same, but "Primitive Land Plants" is an entirely new work. The changes in interpretation are due to Prof. Bower's responses to the additions in the interval to our knowledge of the facts. The book is divided into two parts : Part 1, which occupies

two thirds of its length, deals descriptively with the main subdivisions or classes of Bryophyta and Pteridophyta. The treatment is objective and general interpretations of the morphology are only foreshadowed. These general views emerge into full treatment in Part 2, in the course of a discussion for which the descriptive portion provides the data.

The descriptive account of archegoniate plants is written with the clearness characteristic of Prof. Bower, and is illustrated by a well-selected set of figures, many of which have hitherto had to be sought in original papers. This up-to-date survey will doubtless prove a much needed textbook for students, though this is not its main purpose. The "Origin of a Land Flora" was used with great gain in this way, and the present book has the advantage of dealing with both generations in the life-history.

Tempting as it is to dwell on the treatment of the various groups as described in Part 1, it seems more desirable to bring out some of the author's general conceptions and conclusions. Attention is directed throughout the book to the new light which is thrown on many features of both generations by considering relations of size and form. There is further an excellent brief general treatment of the theory of size as applied to the vascular system in Chapter xxviii. As regards alternation of generations in land plants, the position taken up remains essentially that of the "Origin of a Land Flora", though modified in details. The interesting types of alternation in brown and red algæ are not regarded as bearing directly on the origin of the Archegoniate sporophyte. This is still held to be a stage interpolated in the course of evolution between syngamy and meiosis. Nor is there any change in principle in the treatment of the prothallus and gametangia or of the embryology. The latter leads to the recognition of the primitive spindle, which finds its prototype in the Bryophyte sporogonium, can be connected with Zimmermann's theory of the telome and leads to the increasingly elaborate plant-body of the Pteridophytes. This is seen in its simplest form in the dichotomously branched leafless Rhyniaceæ, and the novelty of the author's evolutionary conceptions becomes evident in considering various progressions from this.

The title of Chapter xxvii, "Axes and Leaves", is intended to indicate that 'leaves' may not be, and indeed almost certainly are not, referable to one type. This is generally accepted when the leaves of the gametophyte as well as the sporophyte are under consideration. The more difficult question concerns the simple and often small leaves of the Psilotales, Lycopodiales and Equisetales on one hand, and the large and compound leaves of the Filicales on the other. In the "Origin of a Land Flora", the megaphyllous type was derived from the microphyllous, by increase of size and elaboration of the leaf relatively to the stem bearing it. A fundamental distinction in origin is now drawn between cladode leaves or megaphylls and microphylls or *Thursophyton* leaves. The strong evidence for the interpretation of the fern frond as derived from an increasingly specialised branch-system is clearly stated. It explains many details, and leads back to the conception of axis and cladode leaf being referable in origin to a common scheme of distal forking.

In emphasising the distinctness of the microphylls from the cladode leaves the alternative term, *Thursophyton* leaves, indicates the weight now attached to the early fossils. Diagrams of the spines or leaves of *Psilophyton*, *Asteroxylon* and *Arthrostigma* bring out the facts of construction clearly. The origin of such leaves in the transition region of *Asteroxylon* and of the Psilotaceæ is most naturally interpreted as by enation and not by branching. On our present knowledge, there is a strong case to be made out for progressions starting from the wholly leafless branch-systems illustrated by the Rhyniaceæ towards the two types of foliar development. A further question is raised by the inquiry whether in ferns with their cladode leaves there are parts comparable with the spines or leaves of microphyllous Pteridophyta. The dermal appendages of ferns have features in common with the microphylls, and comparisons, which may have morphological importance, can be instituted between them. It is pointed out, however, that the resemblances may be homoplastic and not homogenetic.

What is brought out by the comparative survey of the vegetative organs of Pteridophyta acquires further significance in the light of the examination of the spore-bearing members in Chapter xxix. Again only salient points can be noted. The Bryophyte sporogonium, especially as illustrated by that of *Anthoceros*, comes into the comparison not only by way of the problematical *Sporogonites* but also because of the general features of the undoubtedly vascular *Hornea* and *Rhynia*. This leads to a conception of the elaboration of form by way of the branching of a sporogonium-like structure. The sporangia, terminal in *Rhynia*, may be grouped in leafless strobili as in *Zosterophyllum*. Condensation of the ultimate fertile regions of a branch-system gives a natural key to the sporangiophoric condition. To this leafless type of plant the enation of microphylls in the region intervening between the rhizome and the fertile *Hostimella*-like region introduces a further complexity, as illustrated by *Asteroxylon*. In some advanced Vascular Cryptogams, notably in

Equisetum and *Archæocalamites*, the fertile region consists of sporangiophores borne on a main axis without any associated 'leaves'. Comparison with other extinct Equisetales suggests the invasion of this fertile region by microphylls which become a very definite feature of the strobilus. A similar explanation is shown to be applicable in the Psilotales and Sphenophyllales. The constancy of the relation of sporangium and sporophyll in Lycopodiales presents an evident difficulty, but in this connexion it is possible to point to the condition in *Zosterophyllum*, where large sporangia of Lycopod-type form a strobilus free from leaves. While there are no forms showing the invasion of such a fertile region by microphylls, the starting point is illustrated by a known plant.

The above is a condensed statement of a new and interesting interpretation of the strobilus of microphyllous Pteridophytes. Morphologists will have to refer to the evidence in full as it is given in various parts of the book. It should be added that, just as a possible equivalence of the dermal appendages of ferns with microphylls was suggested, so a broad correspondence can be traced between the sorus of ferns and the sporangiophore. The parallel can be further extended, and the sorus with its indusium compared to the sporangiophore with its associated microphyll.

It is scarcely necessary to follow the combination of the general conceptions, some of which have been considered above, into the organographic analysis of the plant in Chapter xxx and the summary of the whole argument in the concluding chapter. Enough has been said to make it clear that this essay, as the author illuminatingly terms it in the dedication to the memory of Dr. D. H. Scott, raises fundamental questions in the morphology of the Archegoniatæ. We are led to consider again aspects of these plants that, unless we are to remain content with mere description, demand some evolutionary explanation. Prof. Bower brings before us the challenge of the facts and the solutions he can suggest. These carry great weight from his life-long study of the group, though he would probably be the first to disclaim for them any finality. But the play of ideas on the facts as known at present keeps interest alive, and new, clearly expressed conceptions are valuable, whether they come to be accepted or lead to the formulation of alternative views. In either case our knowledge is made more coherent, and there is probably no other way in which evolutionary morphology can advance.

The value of the conclusions thus lies partly in themselves, but perhaps of even greater importance is their effect as a stimulus to the search for further facts, whether in the comparative morphology of existing plants, in the fossil history or in experimental morphology. That our general views and working hypotheses are other and fuller than if this book had not been written more than justifies what is said in a sentence on its wrapper. "The author believes that at the end of a long life of research some comprehensive expression of opinion, however tentative and imperfect, would aid students who will carry on the work." It will indeed be recognised by all students of plant morphology that "Primitive Land Plants" adds greatly to the debt which they already owe to Prof. Bower for "The Origin of a Land Flora" and "The Ferns". W. H. LANG.

Israel in the Making

The Heritage of Solomon: an Historical Introduction to the Sociology of Ancient Palestine. By John Garstang. (Herbert Spencer's Descriptive Sociology, continued by his Trustees, Vol. 3.) (Published for Herbert Spencer's Trustees.) Pp. xv+439+4 plates. (London: Williams and Norgate, Ltd., 1934.) 20*s*. net.

THIS contribution to the "Descriptive Sociology" planned by Herbert Spencer, and continued by his Trustees, is the third volume of the new octavo series, and a welcome contrast to the earlier folios. But it seems to have been constructed round the Sociological Index (p. 395) of passages in the earlier books of the Old Testament, and consequently tends to lapse into minute enumerations of archæological or administrative detail, reminiscent of *Numbers* and *Deuteronomy* rather than of *Exodus*. Much of the topographical and strategical material of the author's recent *Joshua, Judges* has, however, been incorporated, and a summary of modern critical hypotheses and interpretations of Hebrew traditional history. Perversely, however, Prof. Garstang "carefully abstained from using" other people's "books as works of reference" and consequently has made some mistakes from which better acquaintance with the literature might have saved him.

Prof. Garstang's own wide experience of life in Palestine and of the 'methods and practice' of excavation furnish him with some interesting parallels and illustrations, but a characteristic inability to come to the point makes the book disappointing to use. The 'J' and 'E' documents "refer most nearly to contemporary events" (p. 12), but to what events? And what is the "accepted theory" on p. 339? "Three vast areas" (p. 13) are "peopled by a more or less kindred stock", but *what* areas, and *which* stock? The Canaanites (p. 23) "were possessed of a formidable arm of war", but we have to wait to learn (p. 108) that their "chief offensive arm" was the chariot, and that Israel had it not. Allusions (p. 186) to

"money", "cash" (p. 67–8) and "silver currency" (p. 86), to an "arterial road" (p. 339), to "democracy" in Gideon (p. 113) and Philistia (p. 257), to "theophoric names" (p. 156), to "a kind of maize" (p. 324) need explanation in a book intended to be popular: on the other hand, it is unnecessary to explain 'cuneiform' more than once. Oaxos is not on the coast of Crete, and Zagros not in Crete at all (p. 231) unless Zakro is meant. If "no distinctively Philistine interments . . . have been recognized" how does the "crater-vase . . . suggest cremation" (pp. 234, 240, 243), seeing that this form is common in burial-chambers in Phœnicia, Cyprus and the Ægean? Surely the "only known attempt to represent Israel's God" on a coin should have had an illustration or at least be identified by reference to one. It does not help much to visualise Solomon's buildings, to be told, as in the Authorized Version, that the doors "like the posts, were 'square in prospect'"; and is it seriously suggested that the private chapels built for Solomon's wives "opened thinking minds to a broader conception of a Godhead that should comprehend all gods"?

Of Solomon himself, Prof. Garstang thinks poorly. Born in the purple, he dissipated his "heritage", and provoked reaction against monarchy and monotheism alike. What is nowhere explained, however, is the unique fame of his "Wisdom"; nor is there any serious attempt here to reconstruct the art, apart from the mere structure, of his Temple. Here, at all events, an excavator might be allowed to guess.

J. L. MYRES.

Universities of the British Empire

The Yearbook of the Universities of the Empire, 1935. (Published for the Universities Bureau of the British Empire.) Pp. xxxi+1057. (London: G. Bell and Sons, Ltd., 1935.) 15*s*. net.

THE publication of the 1935 issue of this annual marks the attainment of its twenty-first year. Like the goddess Minerva, with whom it has a certain affinity, being a yearbook of the learned world, it never knew infancy, but it bears to-day unmistakably the stamp of maturity. It still retains its original characteristic features: (1) a section for each university containing a directory of the officers and members of the staff (the teaching staff being arranged under subject headings), general information about the university's organisation, regulations, etc., and reports of events of outstanding interest which occurred during the past year; (2) an index of names covering all the universities. To these have been added five introductory chapters dealing with the universities of Great Britain and Ireland, of Canada, of Australia, of South Africa and of India, a large number of appendixes containing a vast amount of information, conveniently displayed, about admission to universities, open post-graduate scholarships, professional associations, centres of scientific and industrial research and various other matters and a general index.

The introductory chapters, dealing with the universities' histories, regulations and practice, are readable essays, striking a happy mean between the slap-dash and the unduly elaborate, and are kept up to date by frequent re-editing. Of the appendixes, one shows the countries of origin of university students in the British Isles in greater detail than the returns of the University Grants Committee. It appears that last year more than five thousand students came from abroad: from continental Europe, 1098, Asia 1,739, Africa 888, America 1,070, Australia 355. Of the European students by far the largest quota came from Germany—436. France sent 81, Norway 47, Switzerland 45 and Holland 42. Another gives a useful short bibliography of works relating to universities. When the Yearbook was first compiled it was hoped to arrange all its information in so orderly a fashion that no index other than the index of names would be needed. The ideal was adhered to in theory too long after it had become obviously unrealisable in practice. In recent years a good general index has been perfected. A perusal of the Yearbook, necessarily rather cursory, has brought to light nothing to which exception could reasonably be taken except, perhaps, in the Durham Colleges section, a disconcerting entry: "For early history, see Yearbook for 1929".

The Yearbook has suffered through the untimeliness of its birth—six months before the outbreak of the War—and though its valiant struggle for existence in the stormy period 1914–18 was successful, it found itself thereafter in a world in which the dominance of nationalism has unfortunately not been confined to the political and economic spheres. A generation ago the Yearbook would have had a much larger circulation in foreign countries than it has to-day. Even within the Empire its circulation is not nearly so large as its potential utility should make it. The preface characterises its contents as "such information . . . as may be of interest to members of . . . universities and colleges, to Government departments, clubs, schoolmasters and the public generally". But until public librarians and, it may be added, writers on university topics in the public press, recognise its merits more generally than at present, its utility to the general public will remain almost wholly latent.

Short Notices

General Astronomy. By Dr. H. Spencer Jones. Second edition. Pp. viii+437+28 plates. (London: Edward Arnold and Co., 1934.) 12*s.* 6*d.* net.

SINCE the year 1922, when the first edition of the Astronomer Royal's "General Astronomy" was published, the progress of the science has been truly remarkable. Naturally this cannot be said of all that broad field where advance has been slowly and laboriously consolidated by centuries of patient observation. There is a very wide region where methods and ideas are static. They retain their importance, but descriptions of them once given do not call for constant revision. There is, on the other hand, a part of the science, chiefly in stellar astronomy, where the application of modern physical theory has changed the scene, and ideas are in a state of flux.

The second edition of the Astronomer Royal's work preserves an account of those parts of the subject which may be regarded as standard, but it also includes a new treatment of that domain where progress has been most rapid. The author has succeeded in conveying a remarkably comprehensive view of the present state of the science. It is, of course, a trustworthy picture, perhaps a little overcrowded with detail, but on the whole well proportioned. It must be felt that the work in its new form approaches the limit of what can be reasonably compressed within the bounds of a single volume.

An excellent account of the ideas associated with an expanding universe is included. Here no hesitation is shown in accepting the crude Doppler interpretation of the nebular recession. The difficulty presented by the evolutionary time-scale is clearly stated (§ 276). But no mention is made of such possible ways of escape as that suggested by Prof. W. D. MacMillan in his letter in NATURE of January 16, 1932, p. 93. Can it be that the abstruse is now preferred for its own sake to the simple?

Biomathematics: being the Principles of Mathematics for Students of Biological Science. By Dr. W. M. Feldman. Second edition, reset and enlarged. Pp. xviii+480. (London: Charles Griffin and Co., Ltd., 1935.) 25*s.* net.

THE first edition of Dr. Feldman's book appeared in 1923 and filled a serious gap in mathematical literature. It has now been out of print for some years, and a new edition is to be warmly welcomed, there being still no other book covering the same field. The new edition has been extensively revised and many errors have been eliminated. New chapters, on nomography and on the estimation of errors, have been added. The chapter on biometry has been enlarged, and now forms perhaps the best introduction to this important subject for the biologist with only a small knowledge of mathematics.

Dr. Feldman's choice of matter is good, his exposition is clear, and many of his biological examples are excellent. But it is sincerely to be regretted that he has not sought the criticism of a competent mathematician with regard to the details of his work. Incomplete and misleading statements are not uncommon, and most of them could be eliminated without adding to the difficulties of the reader. The definition of a convergent series on p. 73 is false, as is the statement on p. 124 that the graphs of all cubic functions are *S*-shaped. Examples of such errors could be multiplied. It is to be hoped that a third edition will at some time be called for and that Dr. Feldman will remove these blemishes from his valuable book.

The Journal of the Institute of Metals. Vol. 55. (No. 2, 1934.) Edited by G. Shaw Scott. Pp. 304+17 plates. (London: Institute of Metals, 1934.) 31*s.* 6*d.* net.

THIS volume contains eighteen papers presented at the autumn meeting of the Institute of Metals held in Manchester, together with the thirteenth Autumn Lecture. The latter, delivered by Dr. J. L. Haughton, took the form of a memorial tribute to the late Dr. Walter Rosenhain, and gave an outline of Rosenhain's outstanding contribution to physical metallurgy during his long tenure of office as superintendent of the Metallurgy Department of the National Physical Laboratory.

The most outstanding contribution to metallurgical knowledge contained in this volume comes from the recently founded International Tin Research and Development Council. Mr. D. J. Macnaughtan, the director of research, contributes a paper on "The Improvement of White Bearing Metals for Severe Service", while three other papers sponsored by the same body deal with the behaviour of these alloys under various deformation tests, and present some valuable fundamental data. The very full discussion on these four contributions makes this volume particularly valuable as a work of reference on an important group of alloys.

Bergtechnisches Taschenwörterbuch. Teil 1: *Englisch–Deutsch.* Von Prof. W. Schulz, Prof. H. Louis und Bergassessor Goethe. Pp. 90. (Essen: Verlag Gluckauf G.m.b.H., 1934.) 4.20 gold marks.

THIS is a highly specialised glossary of technical terms used in mining, mining engineering and mining geology. It includes, in addition to technical and scientific terms in general use, special terms peculiar to particular localities. This feature should make it particularly useful to German-speaking individuals who wish to read English mining literature, even though the glossary is not free from inaccuracy and lacks some terms which ought to have been included. The complementary German–English part of this handy pocket glossary is promised.

The Industrial Transition in Great Britain

By DR. K. G. FENELON

DURING the post-War years, important changes have been taking place in the distribution of industries and employment in Great Britain. Some of these are well known and the effects are fully appreciated, but concerning others, facile generalisations are frequently made, and this despite the fact that there are few economic problems in which the statistical information available is so abundant.

During the eleven years 1923–34, unemployment has fluctuated from somewhat less than 9 per cent to about 23 per cent, whereas in pre-War days unemployment varied between 2½ per cent in the best of times to a little more than 10 per cent in the worst. Pre-War unemployment statistics, it is true, are much less adequate than those available to-day, and also certain persons now regarded as unemployed might not have been so regarded before the War, but at any rate it is clear that unemployment is nearly double that of pre-War days. It would be a mistake to imagine that the figures of recent years represent a permanent state of unemployment of something like two million workers, because in actual fact unemployment has been spread in each of these years among five or six million workers—that is, about half of the insured population—some suffering little from unemployment and others severely. There are two kinds of unemployment, one intermittent, the other prolonged, and it is on those in the latter category that the most tragic consequences of the industrial transition have fallen.

How are we to account for the change in the proportion of unemployment since the War? Is it due to the introduction of machinery, and must the inevitable result of scientific progress be that more and more persons will be thrown out of employment? Past experience does not bear this out as inevitable. During the nineteenth century —despite enormous technical progress and a great increase in population—unemployment did not steadily become greater. The popular view that machines are steadily increasing production and at the same time steadily throwing men out of employment cannot be sustained by reference to statistics of production and employment. For example, between 1924 and 1929 the index of production rose from 100 to 111·8 and the employment index increased from 103·8 to 110·5. Nor would it seem, taking industry as a whole, that men are being displaced by women, whatever may be the case in particular industries or occupations. Census returns show that the occupied female population in England and Wales accounted for 30·4 per cent of the total occupied population in 1881, for 29·7 per cent in 1911, for 29·5 per cent in 1921 and for 29·8 per cent in 1931.

After the War, a readjustment from war- to peace-time demands had to be effected, and even more difficult has been the problem of reshaping the structure of British industry to meet the decline in exports which has resulted from industrial development in foreign countries, the imposition of all kinds of restrictions on foreign trade, and technological changes such as the displacement of coal by oil fuel especially in shipping.

Furthermore, the slowing down of the rate of increase of population in so many countries has tended to shift demand from primary to secondary industries, and it is no longer possible for the basic industries providing ordinary necessaries of life to expand at the same rate as was formerly required by ever-increasing populations. These various changes have had severe reactions on British foreign trade, since a disproportionate amount of our industrial resources were engaged in the production of primary commodities.

The changed fortunes of the various industries are strikingly brought out by figures for the years 1923–34 relating to the number of insured persons in employment issued by the Ministry of Labour and published in the *Ministry of Labour Gazette* for December last (London: H.M. Stationery Office), from which the following figures have been extracted. Since both 1923 and 1934 were years of incipient recovery after a period of depression, a comparison between them would seem to be permissible, provided it is borne in mind that the insured population increased in this period by a little more than 16 per cent.

Taking first the depressed industries, those which have suffered a loss in employment of upwards of 10,000 persons each since 1923 are listed in Table 1, fluctuations in employment being shown by means of index numbers for the different years.

Coal mining has shown the greatest contraction owing to loss of export markets, economies in the use of fuel and other causes. The iron and steel trades, on the other hand, have made a marked recovery in recent years owing largely to the tariff. Practically all industries show some improvement in 1934, with the exception of cart and carriage building, which has suffered from the continued development of motor transport.

In marked contrast are the expanding industries, the more important of which, from the point of

view of additional employment afforded, are set out in Table 2.

Altogether, the expanding industries have given employment to the equivalent of all those displaced since 1923 from the declining industries and have provided employment for nearly a million persons in addition. In these industries, many of rather to its success in attracting new industries. Moreover, its typical industries are luxury trades or light industries which have been less hard hit than the old-established industries of the north.

The economic transition which is slowly working itself out becomes more apparent if the expanding industries are classified in groups as follows:

Table 1.
Contracting Industries. Great Britain and Northern Ireland.

Industry	Number Employed		Index Number of Employment (1923 = 100)*			
	June 1923 Aged 16 and over (Thousands)	June 1934 Aged 16–64 (Thousands)	1925	1929	1932	1934
Coal Mining	1,212	623	75·8	74·0	52·7	53·0
Cotton	445	360	117·7	109·0	79·8	81·9
General Engineering	526	444	103·9	105·8	77·3	87·7
Woollen and Worsted	251	181	81·7	85·2	70·7	74·9
Shipbuilding and Ship Repairing	151	81	103·6	108·9	46·4	55·5
Railway (Non-Permanent Service)	179	121	88·3	76·1	65·6	69·9
Iron and Steel	167	127	88·1	89·6	54·0	79·2
Marine Engineering	51	33	94·0	105·9	42·2	65·2
Boots, Shoes, etc.	129	112	100·6	93·1	85·6	89·4
Textile Finishing	102	86	111·2	102·8	84·5	87·7
Jute	36	20	98·4	98·2	56·3	58·6
Pig Iron (Blast Furnaces)	26	12	75·2	80·7	42·6	51·0
Carriages, Carts, etc.	24	12	92·3	74·0	61·9	52·2
Dress-Making and Millinery	110	98	92·0	91·7	87·7	89·2

* A direct comparison between 1923 and 1934 is not possible owing to administrative changes in the insurance scheme in 1927, but the index numbers are based on estimates which serve to link up the figures before and after 1927.

the factories recently built are not inferior to any in the world in respect of equipment, layout or technique.

Further information regarding industrial development has recently been published in a Survey issued by the Board of Trade, which shows that 463 new factories employing 29,500 persons were established in 1933, of which 220 were located in Greater London, 94 in the north-west of England and 63 in the Midlands. In the same year, there were 95 factory extensions, while 409 factories were closed down. Only three of the new factories represented transfers from the north to the south, and of these, two were aircraft factories. The growing industrialisation of the south of England has been due not to the transfer of factories from the north, but

(1) distributive trades and road transport; (2) building and public works contracting, including the construction and provision of materials for houses, shops, public buildings, roads, drainage and other communal services; (3) administrative and organising services, including those of local government, insurance, banking, education, health, office employment and scientific research; (4) new industries and the manufacture of specialised products.

Table 2.
Expanding Industries. Great Britain and Northern Ireland.

Industry	Number Employed		Index Number of Employment (1923 = 100)			
	June 1923 Aged 16 and over (Thousands)	June 1934 Aged 16–64 (Thousands)	1925	1929	1932	1934
Distributive Trades	1,181	1,801	116·9	136·9	149·0	155·4
Building	626	790	112·6	126·8	106·2	132·5
Hotels, Restaurants, etc.	233	359	117·6	136·3	141·8	156·7
Tram and Bus Services	105	174	110·2	147·5	167·0	170·2
Motor-Vehicles, Cycles and Aircraft	174	246	116·4	134·4	114·4	143·2
Local Government	228	295	104·7	120·1	133·9	139·6
Electric Cables, Lamps, Apparatus, etc.	65	122	116·4	139·3	158·5	189·3
Other Road Transport	123	176	113·2	136·0	138·5	147·0
Public Works Contracting	103	153	125·1	136·0	188·0	154·7
Printing, Publishing, etc.	215	257	107·9	119·7	122·1	122·5
Laundries, Dyeing and Dry Cleaning	101	143	110·3	131·1	136·5	143·6
Entertainments and Sports	52	92	113·7	130·7	155·5	180·9
Professional Services	104	141	105·9	115·6	126·2	138·0
Furniture	87	118	110·5	135·2	126·9	140·9
Commerce, Banking, Insurance, etc.	217	246	98·6	103·4	107·4	114·2

The changes in industrial structure revealed by the statistics reflect deep-seated economic and social changes in the life of the community. As examples we may refer to housing, the great development of which is revealed by the fact that between 1923 and 1933 inclusive, some 1,800,000

houses have been built in England and Wales. The spread of leisure has led to a marked expansion in entertainment and sport, while changes in social and domestic habits account for the development of bus travel, the growth of restaurant and hotel businesses and the expansion of laundry and similar trades which provide services formerly carried on in the home.

The new manufacturing industries are much more numerous than is commonly supposed, though the development of many of them is hidden under the generic names in the Ministry of Labour's list. In the development of new industries, or the recent expansion of the old-established trades, scientific discovery or the application of science has played an important part. A long list of such products could be given, but it must suffice to mention rayon; aircraft; motor-cars; electric cables, lamps, motors and apparatus; radio; neon signs; photo-electric apparatus; pharmaceutical chemicals; detergents; synthetic resins and other plastic materials; cinematograph films; refrigerators; solid carbon dioxide; chromium plating; cellulose products; and canned foods. Indeed, the extent to which scientific research is transforming methods of production is seldom fully realised, and, as was stated in a report of the Department of Scientific and Industrial Research, "in nearly every industry to-day, movements are on foot to apply old materials to new uses or to discover uses for new products".

In rayon, the relation of science to industry is conspicuously close, and this industry has made rapid progress in those countries which possessed a well-developed chemical industry. Other thriving new-comers are the plastic industries; the products of which are now extensively utilised not only for accessories of all kinds, but also in the manufacture of silent gear wheels and in chemical engineering, where their resistance to boiling acids and corrosive fumes are of value. Canning is another industry which has recently made rapid progress in Great Britain; expanding its production from about 2–3 million cans in 1925 to more than 100 million cans in 1931. Special problems had to be overcome on account of the high acid content of British fruit, and the difficulties in preserving the colour and flavour. Many ingenious machines have been constructed by British manufacturers for this industry.

In connexion with the building-up of new export trades, scientific applications are an essential asset. Specialised products, combining high quality with skilled workmanship, are frequently assured of a ready sale overseas, such as has been achieved by British manufacturers of light aeroplanes, motor-cars and electrical apparatus. An interesting illustration of the advantages of scientific specialisation in export industries is the almost exclusive utilisation of British photographic and projection lenses in the film studios of Hollywood.

The Professors of the Royal Institution

By THOMAS MARTIN

BY the election on May 7 of Sir James Jeans as professor of astronomy in the Royal Institution, its members have exercised a privilege which has not been used since 1863. Faraday was then the Fullerian professor of chemistry, but he was in his declining years, and Dr. (afterwards Sir Edward) Frankland was elected to a separate professorship of chemistry. Frankland discharged the duties until shortly after Faraday's death in 1867, when Odling became the Fullerian professor and Frankland's professorship was allowed to lapse. The other 'elected' professorship in the Institution at the time, that of natural philosophy, had been established ten years earlier; and was not so short-lived. It was created for John Tyndall when he went to the Institution in 1853, to become the friend and colleague of Faraday in the last fourteen years of his life; and it has continued by election and re-election to the present day.

Lectures on scientific subjects, to be given in a lecture room with the most up-to-date facilities for experiment and demonstration, were a part of the original scheme drawn up in 1799 by the founder, Benjamin Thompson, Count Rumford; and when Rumford's proposals were adopted and the Royal Institution of Great Britain came into existence, the "teaching by courses of philosophical lectures and experiments the application of science to the common purposes of life" was recited as one of its objects in the Royal Charter granted by King George III. The lecture room was constructed, under Rumford's personal supervision, at the house which had been purchased in Albemarle Street; and the procedure to be followed in appointing professors and lecturers was laid down in the by-laws given to the new Institution. The professors were to be elected annually by ballot, and a new professorship could be established at any time, by resolution proposed by fifteen members, which must be carried at one general monthly meeting and confirmed at the next.

The first of the Royal Institution professors was Dr. Thomas Garnett. Trained as a physician, Garnett had already established a reputation in his profession and as lecturer at Anderson's Institution in Glasgow when, in 1799, he accepted the invitation conveyed by Rumford to join the new institution in London. He was elected professor of natural philosophy and chemistry, and on his arrival in December, entered with enthusiasm on his varied duties; but his tenure was not destined to be a long one. After some initial success with his London audience, he found himself handicapped by ill-health, by a certain diffidence as to his own powers, and by his north country accent. Moreover, he worked under the critical eye of Count Rumford, who lived at the Institution at the time, and personally supervised every detail of its activities. It is not surprising that causes of difference appeared. In Rumford's view the lectures given by the professors were those they were requested to give, and the experiments they made were those they were directed to make, by the Managers and the various committees. The work of the professors was but a part of the whole. The Institution, with its library, its workshops, its school for training workmen and mechanics, its repository for models and inventions, was formed for "diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements". It was a part of the philanthropical activity of the day, an attempt to bring to the working classes a knowledge of the useful applications of science.

Garnett found the difficulties of his position too great for him; and resigned his professorship in June 1801. Before he left, a lecturer in chemistry was appointed to share the work. Rumford, writing of the new appointment to his daughter Sarah, in America, said: "We have found a nice able man for his place as lecturer, Humphry Davy"; and in March 1801, Davy was brought from Dr. Beddoes' Pneumatic Institution at Bristol, the place of his experiments on nitrous oxide, to begin the career of exposition and research which was to bring fame to himself and to the Institution in which he worked.

To begin with, Davy, then only twenty-three years of age, was in a junior position; and when Garnett resigned, a new professor of natural philosophy was elected, the Quaker physicist, physician and Egyptologist, Thomas Young. Thus, almost at the outset, the Royal Institution had associated in its work two men, Young and Davy, whose names are among the greatest in English science. Young was engaged at the time on those papers on the theory of light and colours, in which he states his conclusion that "radiant light consists in undulations of the lumniferous ether" and explains the phenomena of interference by means of the wave theory. Although Young was, according to Davy, a most amiable and good-tempered man, his somewhat severe and didactic manner as a lecturer gave him no great success with popular audiences. He held his professorship for only two years, and then retired, to devote himself to his medical work and other pursuits.

Davy became the professor of chemistry, and his work, more than that of any other man, determined the lines on which the Royal Institution was to develop. In the lecture theatre, he possessed all those qualities which Young lacked. He infected his audiences with his own enthusiasm. Such was the charm of his personality and the eloquence of his discourse that he made his scientific lectures one of the fashionable amusements of London. Interest in him was heightened by the discoveries he soon began to make in the laboratory, in particular, those on chemical decomposition by means of the electric current, which enabled him to prepare sodium, potassium and other elements, until then unrecognised. Later came the Continental tour, with Faraday as his assistant, and the discovery of iodine in Paris; and, on his return to the Institution, the invention of the wire gauze safety lamp for miners.

Davy's activities in the laboratory and the lecture theatre established the traditions which have ever since characterised the work of the Royal Institution, of research inspired and largely carried on by the resident professor, and exposition, aided by all the resources of experiment, in terms suited to the layman as well as to the man of science. The Institution continued to attract the "higher ranks of society" whom the early Managers had wished to interest in it as a missionary enterprise depending on their support; but it became also a scientific centre, a place of original research in the problems of pure science which interested the professors. Its scope had become at once wider and narrower than the original intention. The training of mechanics, the construction of kitchens, of models, and other measures for introducing scientific improvements for the benefit of the lower classes, were dropped; although the Managers responsible for the change consoled themselves with the thought that the poor must surely benefit indirectly from the useful activities to which the upper classes of the metropolis could now devote their leisure. Count Rumford, soon after Davy's arrival, had fallen out with the other Managers, and gone to live in Paris, whence he grumbled by letter to Sir Joseph Banks at the change of plan in the institution he had founded.

Davy continued in his professorship until 1813. In the previous year he had been knighted by the

Prince Regent, and now, on his marriage to the wealthy Mrs. Apreece, went to live away from Albemarle Street. He was made honorary professor, and although he gave no lectures, continued to work in the laboratories for some years after. Early in this year he did one of his greatest services to the Institution by engaging Michael Faraday, a bookbinder's apprentice who had shown some interest in science, as his assistant.

The new assistant soon proved his worth, and began the progress which made him eventually Davy's successor, and the connexion with the Royal Institution which was to extend over fifty-four years. His duties were to assist Sir Humphry in his researches and to attend on the other professor and lecturers. W. T. Brande had taken Davy's place as professor of chemistry, and Faraday's first opportunity of demonstrating his powers as a lecturer in the Institution came some years later, when he was called upon to take Brande's place in an emergency.

Faraday's training in his years as Davy's assistant made of him a good chemist and a skilled experimenter. His first attempts at research of his own were naturally on chemical problems, and early successes were the discovery of new compounds, including in particular "bicarburet of hydrogen" (benzene). The news of Oersted's experiments at Copenhagen set Davy to work on electromagnetism, and stimulated scientific interest all over Europe. Faraday, following the developments closely (since his tour in 1813–15 in France and Italy with Davy he knew some of the men whose papers he was reading), had by 1821 made his own contribution to the subject by his discovery of the electro-magnetic rotations. It was the beginning of his electrical researches.

The audiences in the lecture theatre discovered, too, that the young assistant had powers of his own. Brande, who retained his professorship until 1852, was not, it seems, an inspiring lecturer. Faraday, whose methods were less impulsive than those of Davy, had fluency and address at the lecture table, with a genius for apt experiment, and as the years went by he outshone his former master in his ability to fill the lecture theatre and stir in his audience some reflection of his personal enthusiasm.

In 1833 a new professorship was established, of a different kind from the others. John Fuller, a wealthy landowner and member of Parliament, made a gift of money for the endowment of what was called the Fullerian professorship of chemistry, the appointments to which were to be made by the Committee of Managers, and were not subject to annual re-election by the members. Faraday became the first Fullerian professor, and occupied the chair until his death in 1867.

It is difficult to speak of Faraday's professorship in a few words. It may be said that for nearly forty years, from the moment when in 1825 he became Director of the Laboratory following Davy's statement that "he considered the talents and services of Mr. Faraday, assistant in the laboratory, entitled to some mark of approbation from the Managers", he carried the Institution on his shoulders. He upheld and extended the traditions which Davy had originated. Two of the characteristic activities, the Friday evening discourses and the Christmas juvenile lectures, owe their inception almost entirely to Faraday. To his audiences, he was without a rival in his mastery of the arts of exposition and demonstration by experiment. His discovery of electromagnetic induction and his researches in electro-chemistry and electrostatics made him the first man of science of his age.

Fuller had endowed a second professorship in 1834, of physiology. Unlike that of chemistry, the Fullerian professorship of physiology was to be held for a fixed term of three years. P. M. Roget was the first professor, and he has been followed by a line of distinguished men. The list includes the names of T. H. Huxley, Sir Richard Owen, Sir Michael Foster, Sir Edwin Ray Lankester, and more recently Sir Charles Sherrington, Sir Arthur Keith and Sir Grafton Elliot-Smith.

Tyndall owed his connexion with the Institution to the favourable impression he made when, as a young physicist of promise, after a period of work in Germany, he was invited to give a Friday evening discourse. His election in May 1853 as professor of natural philosophy followed, and the later years at least of his professorship must be within the memory of many now living. It is said that he and Faraday worked together in the closest harmony, and that the relations of the older to the younger man resembled those of a father to a son. On Faraday's death in 1867, Tyndall followed him as the resident professor, and lived at the Institution until his retirement in 1887. He did valuable experimental work on the radiation and absorption of heat by gases and vapours, and his discovery that bacteria will not breed in dust-free air has been of great importance ; his work on sound was done as scientific adviser to the Trinity House, in which office he succeeded Faraday. He is perhaps best remembered as an expositor, for his animation and lucidity as a lecturer and for the felicity of his style as a popular writer on science.

William Odling, who succeeded Faraday as Fullerian professor of chemistry, resigned in 1873, after five years. He was followed, for another period of five years, by Dr. J. H. Gladstone, who in turn was succeeded, in 1877, by Professor

(afterwards Sir James) Dewar. This was the beginning of another long tenure, for Dewar held the professorship for forty-six years, until his death in 1923; and from 1887, after Tyndall's retirement, he lived at the Institution as the resident professor.

Dewar's matchless skill as an experimenter, the fame of his researches, and of his Friday evening lectures with their carefully prepared and rehearsed demonstrations, are well known and remembered. In the Royal Institution laboratories, with apparatus often on an engineering scale, he liquefied the so-called permanent gases, and produced them for the first time—oxygen, hydrogen and air—in quantities sufficient for experiments on the properties of materials at the very low temperatures he reached; he invented, as a container for the cooled gases, the 'thermos' or Dewar flask; and he developed the method, of great technical importance, of making high vacua by using the great absorbing power for gases of charcoal cooled in liquid air. These are but the best known among his achievements. To quote the words of a distinguished contemporary: "He was . . . in no way less successful than his predecessors, Young, Davy and Faraday, in adding to the reputation these pioneers created for the Royal Institution as a centre of scientific discovery and invention". It may be added that the recent lamented death of Lady Dewar is a reminder that not the least important of the Dewars' services to science was given as host and hostess in their house at the Institution.

Since Tyndall, three physicists of great distinction have held the professorship of natural philosophy who have also been, in turn, the Cavendish professor of physics at Cambridge. The late Lord Rayleigh, soon after his retirement from Cambridge, accepted the invitation to the chair at the Royal Institution, and held it until 1905; when he was succeeded by Sir J. J. Thomson. The present professor, Lord Rutherford, took up the duties in 1921. The rules prescribed at the beginning of the Institution for the election of professors are still followed; and thus it is that Lord Rutherford, as an 'elected' professor, must seek the suffrages of the members once a year, while Dewar's successor in the endowed Fullerian professorship of chemistry, the present resident professor, Sir William Bragg, does not do so.

Obituary

Mr. C. F. Cross, F.R.S.

MR. CHARLES FREDERICK CROSS, who died in his eightieth year on April 15 at Hove, where he had lived in retirement for some years, left us indebted to him for a life devoted to a most difficult and unpromising branch of chemical research, rewarded by an epoch-making discovery, which is represented in Great Britain to-day by an artificial silk industry with a market capitalisation of more than £70,000,000. He was educated at King's College, London, the University of Zurich and Owens College, Manchester. In 1879, his work on the cellulose group commenced with a study of jute, and later, in association with Mr. E. J. Bevan and Mr. C. Beadle, he started the well-known business of Cross and Bevan, consultants to the paper trade.

It is difficult to estimate the number of papers on the chemistry of cellulose published by Cross and his collaborators; these date from 1880 until 1920, and appeared in the *Journal of the Chemical Society*, *Journal of the Society of Dyers and Colourists*, *Berichte*, *Phil. Mag.*, *Bull. Soc. Chim.*, and many less-known publications. In these and in his textbooks, he has left us a mine of information and, as Prof. H. E. Armstrong has pointed out, the mystic character of some of his explanations must be ascribed to the intangible nature of his subject. Fulfilling the functions that it does in the plant, cellulose is on the border-line of living substances itself, and is liable to alter with every change in conditions to which it is subjected. His suggestion that it is an 'amphoteric electrolyte' hides a complexity of behaviour that has not been much illuminated by more modern advances in chemical language.

In 1892, Cross discovered that, by virtue of the alcoholic properties of cellulose, a soluble xanthate could be obtained on reaction with caustic soda and carbon disulphide. Working at Kew with Stearn and Topham, who were at first interested in the application of the new discovery to the manufacture of electric lamp filaments, the practical difficulties in spinning a continuous textile fibre were overcome, and the viscose silk industry was born.

At first, the solution of cellulose xanthate was expressed through a number of fine holes into a solution of ammonium sulphate, and the use of an acid bath, which resulted in the formation of a cellulose thread in one operation, was not arrived at until years later. The reception of the thread in a centrifugal box, which collected, drained and twisted it in one operation, due to Topham, has remained the standard practice up to the present day. In 1905, manufacture was started by the firm of Courtauld at Coventry, and the writer, then in charge of the chemical department, has a lively recollection of Cross, who took a great interest in the new venture, with his interesting suggestions, cheery sporting manner, wide culture and artistic interests.

Recognition of the value of Cross's work came later; in 1917 he was elected fellow of the Royal Society, in 1916 he received the medal of the Society of

Chemical Industry and in 1918 the research medal of the Worshipful Company of Dyers. He was elected president of the Society of Dyers and Colourists in 1918, and received the Perkin Medal in 1923. SIDNEY S. NAPPER.

COLONEL W. G. KING, C.I.E.

COLONEL WALTER GAWEN KING, late of the Indian Medical Service, died at his home at Hendon on April 4 at the age of eighty-three years. He graduated M.B. and C.M. in 1873 at the University of Aberdeen, where he also took the D.P.H. in 1888. Soon after qualifying, and before his twenty-third birthday, he entered the Indian Medical Service, in which he passed the next thirty-six years of his life.

On reaching India in 1874, King was posted to the Madras Presidency and, after two years military service with an Indian regiment, was transferred to civil employment, in which he quickly distinguished himself for his active work in the great famine of 1876–77 and the terribly severe cholera epidemic which accompanied it. This experience made him decide to devote his life to preventive medicine, and it is chiefly for the remarkable work which he did in this sphere during a succession of appointments as inspector of vaccination, deputy sanitary commissioner and sanitary commissioner of the Madras Presidency and later as inspector general of civil hospitals and sanitary commissioner of Burma, that his name will go down to posterity as the leading pioneer of public health in southern India.

King's great merit was that at a time when smallpox, cholera and malaria were the three chief scourges of India, and when the scientific world knew nothing of the causes of cholera or malaria, and, therefore, knew nothing of their prevention, he set to work to organise scientific investigations for the benefit of public health and did not pause in the task until the goal he aimed at was attained. At that time, bacteriology was in its youth and the modern sciences of tropical protozoology, helminthology and medical entomology were in their earliest infancy or were as yet unborn. The malaria parasite was not discovered until 1881, and the fact that it is spread by mosquitoes not until 1897. The cholera vibrio was not discovered until 1883. Smallpox, however, could be controlled because a prophylactic was already available and the only problem to be solved was how best it could be applied. In Madras, vaccination with animal lymph instead of with human lymph was successfully established in 1880–81, but more than ten years were to elapse before a satisfactory method of preserving the lymph under tropical conditions was devised. King's well-planned and carefully controlled laboratory experiments conducted in 1890 to ascertain the relative merits of lanoline and vaseline as a preserving medium may be cited as a good example of the immediate utilitarian researches to which he devoted what time he could spare from his many other duties.

Later when, at his repeated request, the Government of Madras established a central animal vaccine lymph depot for the Presidency, King quickly extended its work to include bacteriological diagnosis and other expert assistance to civil surgeons and medical practitioners, and finally made arrangements for the preparation of prophylactic and curative sera and vaccines and for the prosecution of original protozoological and entomological research of direct importance to tropical medicine. In 1903, when the main buildings of the bacteriological section were completed, the Institute became the provincial laboratory for the Madras Presidency and was named, in recognition of King's services to public health and the efforts he had made to bring it into existence, "The King Institute of Preventive Medicine". In the general scheme for laboratories which had been submitted to the Government of India by the late Surgeon-General Harvey in 1899 it was the third to be established, being preceded only by the Haffkine Institute at Parel, Bombay (1896–99), and the Pasteur Institute of India at Kasauli (1900).

After his retirement, Colonel King served in the War from 1916 as A.D.M.S. Western Command and later was consultant at the Tropical Diseases Clinic, Ministry of Pensions, and lecturer in applied hygiene in the tropics at King's College, London. He had the satisfaction, too, of seeing the institute in India which he founded grow gradually until its activities covered a wider field in the practical application of scientific knowledge to routine medical and public health needs than those of any other laboratory in India. S. P. J.

PROF. R. CARR BOSANQUET

WE regret to record the death of Prof. R. Carr Bosanquet, formerly professor of classical archæology in the University of Liverpool, which took place on April 21 in a nursing home at Newcastle at the age of sixty-three years.

Robert Carr Bosanquet was the son of Mr. Charles Bertie Pulleine Bosanquet, and was born at Rock Hall, near Alnwick, on June 7, 1871. He was educated at Eton, where he was Newcastle Scholar in 1890 and edited the *Eton College Chronicle*, and at Trinity College, Cambridge, of which foundation he was a scholar. He took firsts in both parts of the Classical Tripos, and was elected to a Craven travelling studentship, which he held from 1895 until 1897.

Bosanquet's interest in archæology was first aroused by the antiquities of Roman Britain which lay within striking distance of his home. In 1897 he excavated Housesteads (Borcovicium) on the Roman Wall. In the following year he was appointed assistant director of the British School of Archæology in Athens, later succeeding to the office of director. In 1906 he was elected to the chair of classical archæology in the University of Liverpool, which he occupied until 1920, when he retired in order to devote himself to the management of the estate which he had inherited from his father, giving such time as this allowed him to further research in the archæology of Roman Britain. He was a member of the Royal Commission on Ancient Monuments in Wales, a position for which his extensive knowledge

of Welsh antiquities peculiarly fitted him, and of the advisory board on Ancient Monuments in England.

As an archæologist, Bosanquet had a high reputation among the expert, but neither his achievement nor its qualities was such as to lend itself to building up wide popular recognition. He was one of the group who, following closely in the footsteps of Sir Arthur Evans, at the turn of the century and in the years immediately following placed British archæology in the field in a commanding position in international scholarship; and Bosanquet was one of those who helped to extend that meticulous care in excavation, characteristic of field work in the Mediterranean, to the study of Romano-British sites. As director of the British School at Athens he worked in Crete, where he was responsible for the excavation of the archæologically valuable site of Palækastro, at Phylakopi and in Laconia, where he initiated the important excavation of the temple of Artemis Orthia. He was the author of "Borcovicium" (1904) and part author of "Phylakopi" (1904), but the principal part of his contribution to archæological literature appears in the *Annual* of the British School, the *Journal of Hellenic Studies* and other periodicals. His work was accurate and precise, and informed with wide knowledge. It showed all the polished definition to be expected of a finished scholar.

Prof. E. Poulsson

With the death on March 19, at the age of seventy-seven years, of Prof. E. Poulsson, Norway has lost one of her foremost scientific workers. He was chiefly known on account of his work in connexion with the fat-soluble vitamins as they are found in cod liver oil. In innumerable papers he has shown that the female organism in the sexually mature years has a greater vitamin reserve than the male. Similarly, he has proved that the chondropteryginous fishes—in contradistinction to the osseous—are only endowed with negligible quantities of vitamin D, a substance which they manifestly do not require as their framework is only to a very limited extent composed of lime compounds.

Prof. Poulsson was deeply interested in the importance of cod liver vitamins to the growing organism. He showed in several papers the part played by these vitamins in relation to the unborn individual and in habitual abortion, and he did much to extend our knowledge of the medicinal importance of cod liver oil. One of the most important of Prof. Poulsson's contributions to the cause of vitamin research is undoubtedly his well-known method for the quantitative determination of vitamin D. By this method vitamin D was determined in Oslo-units and these were in use in many countries until the international units were introduced. As Norway's representative, Prof. Poulsson was a member of the League of Nations Vitamin Standardisation Committee.

In the sphere of pharmacology Prof. Poulsson was particularly well known. His textbook on this subject is used in many parts of the world in English, Spanish and German translations, and ten editions have been published. The book successfully combines theoretical thoroughness with practical insight. Written in an easy style, it is an invaluable aid for the ordinary practitioner.

Prof. Poulsson was born in 1858. He became a doctor of medicine in 1892, studied chemistry under Fresenius at Wiesbaden and pharmacology under Schmiedeberg at Strasbourg. He was professor of pharmacology at the University of Oslo in 1895–1928. As professor emeritus from 1928 until his death, he was director of the State Vitamin Institute. His charm and directness of manner gained him many friends both at home and abroad.

Ottar Rygh.

The death of the eminent American medical historian Lieut.-Colonel Fielding Hudson Garrison at the age of seventy-four years took place on April 18 in the Johns Hopkins Hospital. He was the author of an introduction to the "History of Medicine" (fourth edition, 1929) and numerous articles on the history of medicine, as well as co-editor for some years of the *Index Medicus*, *Quarterly Cumulative Index*, and *Annals of Medical History*, consulting librarian to the New York Academy of Medicine and librarian to the Welch Medical Library at Johns Hopkins University.

We regret to announce the death on April 9 of Dr. Edouard Antoine Jeanselme at the age of seventy-four years; he was formerly professor of diseases of the skin and syphilis in the Paris faculty of medicine, author of an authoritative work on leprosy (1934) and editor of a treatise on syphilis in several volumes in course of publication.

We regret to announce the following deaths:

Prof. J. E. Guthrie, professor of zoology in Iowa State College, on April 16, aged sixty-three years.

Prof. T. C. Hopkins, formerly professor of geology in Syracuse University, known for his work on building stones, clays and iron ores, on April 3, aged seventy-three years.

Prof. George E. Johnson, professor of zoology in the Kansas State College, an authority on the physiology of hibernation, on March 18, aged forty-five years.

Prof. Wilhelm Kolle, director of the State Institute for Experimental Therapy and of the Georg-Speyer-Haus Chemo-Therapeutical Institute, Frankfurt, on May 10, aged sixty-four years.

Prof. J. L. R. Morgan, professor of physical chemistry in Columbia University, on April 12, aged sixty-two years.

Prof. E. B. Skinner, emeritus professor of mathematics in the University of Wisconsin, on April 3, aged seventy-one years.

Dr. H. H. Thomas, F.R.S., petrographer to H.M. Geological Survey, on May 12, aged fifty-nine years.

Sir James Walker, F.R.S., emeritus professor of chemistry in the University of Edinburgh, on May 6, aged seventy-two years.

Supplement to NATURE

No. 3420 MAY 18, 1935

Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 834.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Magneto-Optic Rotation

THE subject of the influence of magnetism on light has again been coming into experimental prominence, combined, however, with confusion on the side of theory: and a brief exposition of some considerations which I have treated more privately more than once may be to the public advantage.

One may recall that this influence was one of the grand discoveries of Faraday, guided by his own instincts, to be classed as regards mode with the Einsteinian assertion of the relation of gravitation to radiation and its spectrum. It was eagerly seized upon by Lord Kelvin, with his engineering instincts, as sheer demonstration that in magnetism there is involved dynamical spin round its axis. The electron theory permitted this spin due to magnetisation to be calculated, and conversely: and the experiments that have been going on (Barnett, de Haas and Einstein, Sucksmith, and others) have verified the computed result except for a factor which seems to be exactly 2, and demands a more refined theory scarcely yet suitably envisaged.

The subject, thus indicated as being at the very foundations of physical science, occupied several chapters, largely speculative, in the second volume of Maxwell's "Electricity and Magnetism" (a book nowhere really much known except in Great Britain and America) which appeared only about sixty years ago, thus being not quite so old as the "Principia". But formulæ thereby suggested, mainly on a vortical basis, for the magneto-optic rotation were passed in review, in relation to such experimental data as then existed, satisfying Verdet's law that the effect was roughly governed as a main factor by the inverse square of the wave-length. Afterwards a formula was advanced by the physicist, P. Drude, in his "Treatise on Optics", familiar in an American translation; but this appears to be restricted to the very different problem of *natural rotation*, introduced optical dispersion into the result, giving the optical rotation R in terms of the wave-length λ by a formula, containing a term for each spectral band λ_r in the form

$$R = \Sigma \frac{A_r}{\lambda^2 - \lambda_r^2},$$

in fact, of the same type as the formula for refraction, $\mu^2 - 1$, in a gas.

About 1897 by a happy chance an expression was hit upon for the magnetic case by Henri Becquerel, the discoverer of radioactivity (with whom I was acquainted mainly through Lord Kelvin), which made R equal to the very simple form $e/2mC.\lambda\, d\mu/d\lambda$, where e is the electron charge and C the velocity of light. This has been abundantly tested and comes right except for a factor which (according to Prof. C. G. Darwin) is usually about 3/5. Thus, generally R is as the gradient of μ. To obtain a formula, for a gas

$$\mu^2 - 1 = \Sigma \frac{B_r}{\lambda^2 - \lambda_r^2},$$

giving

$$\mu R = \frac{e}{2mC} \frac{-2B_r\lambda^2}{(\lambda^2 - \lambda_r^2)^2}$$

close to each absorption band where λ is nearly equal to λ_r. This of course makes R great, but of the same sign on both sides of the band (in agreement with observations by Macaluso and Corbino at Palermo); whereas the formula of Drude makes the natural rotation of different signs, a result capable of test. I remember this contrast, because a hasty assertion by slip of pen to the contrary in "Aether and Matter" (p. 353) was soon challenged by my friend Prof. R. W. Wood, of Baltimore, who was experimenting on the subject, to whom therefore might be said to belong the actual type of inappropriateness of the Drude formula. This happens to be of peculiar interest in connexion with the remarks in this and more general regards, on R. W. Wood's "Physical Optics", made in NATURE of March 2, p. 325, which suggested the present note as a useful antidote.

The Becquerel magnetic formula as above may be written

$$\mu R = \frac{e}{mC} \Sigma \left\{ -\frac{B_r}{\lambda^2 - \lambda_r^2} - \frac{B_r\lambda_r^2}{(\lambda^2 - \lambda_r^2)^2} \right\},$$

the ratio of the second term to the first being $\lambda_r^2/(\lambda^2 - \lambda_r^2)$: thus if λ_r is very small compared with λ the first term, of Drude type, suffices, so that R_r could be regarded as due to one abnormally potent band of absorption in the remote ultra-violet, whereas near the band it is the other term that prevails.

The coefficient in this Becquerel formula applies for a gas. For a dense substance the Lorentz expression $3(\mu^2-1)/(\mu^2+2)$ must take the place of (μ^2-1) on the left, and differentiation gives a different factor in R which would make a very considerable difference near the band of absorption.

The necessary references, those available here remote from a library, are *Trans. Camb. Phil. Soc.*, Stokes Commemoration Vol. (1900) § 7, as reprinted in the writer's "Collected Papers", vol. 2, p. 179, which gives a reference to a comparison with records of experiments drawn up by Prof. C. G. Darwin, *Proc. Roy. Soc.* (1927): and also my 'Aether and Matter' (1900), p. 353, where §§133–8 connect the trend of rotation with that of K or μ^2.

A suggestion of more constructive character is led up to by the assertion of the 'obsoleteness of damping' for the discussion of refractive dispersion and absorption. It is not difficult formally to include a frictional term in the Maxwell-Sellmeier formula for dispersion : if one remembers aright, Maxwell had done so. In his book "Magneto-Optik", the eminent Göttingen physicist Woldemar Voigt had doubtless included both magnetic and frictional terms in his scheme of equations, though in a way that would now be regarded as scarcely more than illustrative. His resulting triple division of the absorption line, in fact the inverse form of the simplest type of Zeeman effect, would thus be influenced as regards positions and intensities by the damping which need not be negligible for transmission through dense media. Hitherto it appears to have been position and polarisation of the components that have been mainly treated. But now astronomers have in their hands delicate instruments that can trace the intensity of impression across the broadened line on the photograph with precision. If they can provide data from the Zeeman broadening, this would appear to go some way towards doubling the material with which specialists have to deal in this intricate but promising domain.

JOSEPH LARMOR.

Holywood, Co. Down.
March 4.

Concentration of Artificially Produced Radioelements by an Electric Field

ONE of the best methods of collecting radioelements free from any inactive material is the application of an electric field, either to the gaseous or liquid phase. Well-known examples of the former process are the collection of the 'active deposits' produced by the three emanations ; of the latter, the electrolytic deposition of these and other isotopes of lead, bismuth and polonium. It seemed worth while to investigate whether an electric field might also be of help in concentrating the newly discovered artificial radioelements. Especially interesting is the question as to their possible charge when produced in gases by fast and slow neutrons.

In our experiments the neutrons were obtained from 30 millicuries of radiothorium mixed with powdered beryllium, and slowed down by water. The field was applied by using a silver flask with an inner electrode, usually in the form of a platinum wire. Each experiment was performed with this electrode charged to +1300 volts and −1300 volts alternately (about 300 volt/cm.). For various reasons, arsenic seemed one of the most suitable elements and consequently most of the experiments have been done with arsine. As is well known, this compound tends to react on the walls, leaving a deposit of arsenic, but by purifying the gas carefully we were able to suppress its spontaneous decomposition almost completely. As Fermi and his co-workers have shown[1], slow neutrons produce the change $As^{75}+n^1 \rightarrow As^{76}$, the latter losing its activity with a half-value period of one day.

Without a field no activity whatever was found on the wire, even when this had acquired a visible coating of arsenic. Application of the field, however, in either direction, resulted in the collection on the electrode of up to 30 per cent of the total activity produced by the neutrons, together with only about 0·02 per cent of the total inactive arsenic, the concentration factor (that is, the change in the ratio As^{76}/As^{75}) being in this case 1,500.

From these experiments it appears that any characteristic charge which may be imparted to the active arsenic isotope at the moment of its formation is not retained ; it is probable that solid arsenic particles are formed[2], which acquire a charge by catching the ions present in the gas. The failure of Fermi and his co-workers to obtain an appreciable improvement in the yield by applying a field to the vapour of methyl and ethyl iodide[3] was probably due to the high vapour pressure of iodine, or to exchange processes. We varied the experimental conditions in different ways : by changing the pressure of the arsine and the metal of the electrode, by adding hydrogen or water vapour, and by increasing the ionisation by an additional radiation. Even when by these variations the chemical decomposition was so much accelerated as to cause the deposition of a layer of arsenic on the electrode of a thickness of about 10^{-4} cm., the yield of the active isotope was only very slightly increased. On the other hand, we were able to collect up to 20 per cent of the active isotope on either electrode without any visible layer of arsenic. In such experiments the concentration factor was certainly greater than 20,000.

We think that this method of concentration by an electric field will be of practical use whenever very thin layers of the new radioelements are required. There is no reason why it should not be applied to the collection of the non-isotopic radioactive atoms produced by fast neutrons. Here, in the distribution of the charges, a recoil effect will possibly be found. The method will also be extended to liquid systems, to which preliminary experiments, in which Dr. E. Glückauf has assisted us, have shown it to be applicable.

F. A. PANETH.
J. W. J. FAY.

Physical and Inorganic Chemistry Department,
Imperial College of Science and Technology,
London, S.W.7.
April 16.

[1] Fermi, Amaldi, D'Agostino, Rasetti and Segrè, *Proc. Roy. Soc.*, A, **146**, 483 ; 1934.
[2] cf. Szilard and Chalmers, NATURE, **134**, 462 ; 1934.
[3] *Ricerca Scientifica*, **5** ; December, 1934.

Nature of Cosmic Rays

IT seems quite certain that it is not possible to explain all the effects of cosmic rays by means of a single corpuscular component. On the other hand, the results of the direct measurements of the energy of the rays, by their curvature in a magnetic field, are difficult to reconcile with the existence of any simple relation between their energy and penetrating power. I want, therefore, to suggest a dualistic theory of the cosmic rays, based on the existence of two primary components, both of great energy, but which are absorbed very differently by matter[1].

The primary corpuscular rays, on arrival at the top of the atmosphere, are supposed to be formed of a mixture of electrons (perhaps of both signs) and of heavy particles, such as protons. These particles, which we may call the *M* and the *D* groups, have energies of the same order, which at a latitude of 45°, lie between 4×10^9 and 10^{11} electron volts. There must be a large number of particles of group *M* to

one of group D. In traversing the atmosphere, they suffer both a slow loss of energy and also large collision losses due to the formation of secondary electrons and photons. The coefficients of absorption for the electrons are about 5×10^{-3} cm.^{2}/gm. and for the protons $0{\cdot}7 \times 10^{-3}$ cm.^{2}/gm. In light elements, the absorption of both components is nearly proportional to the density of the absorbing material. The greater the absorbing material traversed, the stronger is the component D relative to M, until, under 20 metres of water below the top of the atmosphere, M has nearly disappeared[2]. In dense matter of low atomic weight (water, earth, etc.), the formation of secondaries (electrons and photons) at close intervals determines the creation of multiple rays capable of producing coincidences in counters placed out of line.

If the two groups of rays traverse heavy elements such as lead, they behave quite differently. The absorption of the D particles is proportional to the mass of matter traversed, and is accompanied by the formation of secondaries and perhaps of showers, as in light elements. The M particles, on the other hand, suffer very intense absorption due to the emission of radiation during nuclear collisions. The photons produced have a short path in lead and give rise to numerous electron-positron pairs. This is the origin of the typical shower, such as determines the typical maximum of Rossi's curve.

The concentrated type of shower can be attributed to the occurrence of an absorption process in the interior of a piece of heavy material, and the diffused shower to an absorption process occurring near a free surface, so that the ejected photons spread out and are then absorbed by surrounding dense objects. After the decrease which follows the maximum of the curve of showers, that is after 6 cm. of lead, only component D remains, and the remaining multiple coincidences are to be attributed to secondary effects of this component, with possibly a few showers. Rossi's curve is really due to the superposition of the multiple secondary effects of M and of D. If one works at a place where M has disappeared, no typical maximum is found, but only the effect of D.

The absorption of the two groups of particles can be studied by the interposition of screens between the counters as arranged vertically for counting coincidences. The curves so obtained for lead show an initial rapid decrease due to the absorption of the secondary rays, and of group M, and then after 10 cm. a slow decrease due to D. With matter of lower atomic weight, such as copper, one obtains different curves, in which the rapid decrease due to the absorption of the secondaries is followed by that of group M, and after 20 cm. by the slow decrease due to D.

Actually the collision absorption, which increases with the atomic number of the atoms forming the screen, is much smaller in copper, corresponding to the smaller production of showers. One can show by absorption in lead that after traversing 8 cm. of copper, there still remains a considerable part of M; the rapid decrease which additional lead then produces is the same as that at the start of the absorption curve in lead. After M has disappeared, the component D continues alone, with the same mass absorption coefficient in all materials.

PIERRE AUGER.

Faculty of Science,
Paris.

[1] P. Auger, *C.R.*, **200**, 739; 1935.
[2] P. Auger, A. Rosenberg and F. Bertein, *C.R.*, **200**, 1027; 1935.

Cosmic Rays and Novæ

IN dealing with this subject in a recent letter[1], I most unfortunately overlooked some recent work of W. Baade and F. Zwicky[2]. These authors have advanced the highly interesting theory that cosmic rays have their origin in outbursts of *super*-novæ in extra-galactic nebulæ, and did so a year before the appearance of Nova Herculis prompted a search for a possible connexion between cosmic rays and nova phenomena in general. Super-novæ are thought to occur in each nebula about once in a thousand years, and, from certain hypotheses about what happens during an outburst, Baade and Zwicky show that they probably release energy sufficient to maintain the supply of cosmic radiation as observed at the earth.

I should emphasise that in my own note I offered no theory of the origin of cosmic rays, but sought merely to answer the question: Can ordinary nova outbursts in our own galaxy supply energy sufficient to give the observed intensity of cosmic radiation? I expected a negative answer. The method I followed in estimating the energy is due to Milne, and is independent of any hypothesis as to what happens actually during a nova outburst. It turned out in point of fact that, on the present knowledge of stellar structure, one cannot definitely exclude the possibility of this source of the radiation, *on energy considerations alone.*

W. H. MCCREA.

Imperial College of Science
and Technology,
S.W.7.
April 17.

[1] NATURE, **135**, 371, March 9, 1935.
[2] *Proc. Nat. Acad. of Sci.*, **20**, 254, 259; 1934. *Phys. Rev.*, **45**, 138; **46**, 76; 1934.

The 'Lipotropic' Effect of Protein

EVIDENCE that proteins or substances closely associated with proteins exert a 'lipotropic'* effect has been reported previously from these departments[1,2]. In the latter paper it was shown that when rats with fatty livers were placed on a choline-free diet consisting exclusively of sucrose, an increase of some 8 per cent of liver 'fat' was observed to take place within six days. In a comparable experiment in which the ration contained 20 per cent protein as 'fat-free and vitamin-free casein' and 80 per cent sucrose, no increase in liver fat was observed at the end of six days. It was also shown that 5 mgm. of choline exerted a very definite effect on the liver fat of animals receiving a diet low in choline and containing 20 per cent fat. This effect may be regarded as much greater than that of the casein, and the results of more recent experiments indicate that as little as 1 mgm. of choline daily exerts at least as great a 'lipotropic' effect as 2 gm. of the alcohol and ether washed casein which we have used.

In several series of hitherto unpublished experiments in which large groups of animals were used, extensive deposition of liver fat has been obtained consistently with diets low in 'lipotropic' factors but containing 15–21 per cent protein and 3–40 per cent

* The term 'lipotropic' is used to describe substances which decrease the rate of deposition and accelerate the rate of removal of liver fat.

fat. In a series of fifty animals in which a diet low in choline, but containing approximately 40 per cent fat and 21 per cent protein was provided, the average fat content at the end of three weeks was approximately 17 per cent. This figure may be contrasted with that reported recently by Channon and Wilkinson[3]—12·5 per cent for one series of six animals which received 40 per cent fat and 5 per cent protein, and 8·9 per cent for another which received the fat and no protein. The 'lipotropic' effect of protein *per se* is not apparent from the comparison of these results from the two laboratories. The simplest explanation is that the diet used by Channon and Wilkinson contained more non-protein 'lipotropic' factor than the one which we employed.

The results in Table I show that in nine of the ten rats in a group receiving 15 per cent protein and only 20 per cent fat, excessive amounts of fat accumulated in the liver within fourteen days. The deposition is as extensive as Channon and Wilkinson secured with double the amount of fat and one third the amount of protein in the diet. The average gain in weight in the two groups of animals was of the same order.

Table I. Duration of Experiment, 14 Days

Rat No.	Initial Wt.	Final Wt.	Cal. per day	Total Fatty Acids of Liver	* Diet
	gm.	gm.		per cent	per cent
1	166	172	60	18·6	Casein 11·5
2	146	154	51	9·1	Dried egg white 3·5
3	168	180	56	4·4	'Crisco' 20·0
4	140	144	41	11·6	Sucrose 58·3
5	146	136	46	18·5	Salt mixture 4·8
6	154	168	52	12·9	Agar 1·9
7	156	170	47	10·4	Vitamins A and D concentrate
8	176	184	58	14·3	Vitamin B_1 concentrate
9	156	154	56	15·7	
10	150	152	41	20·2	Choline content 1·25 mgm./100 gm.
Av.	155·8	161·4	51	13·6	

* Average daily food consumption was 10·7 gm. containing 0·134 mgm. choline.

In another section of their paper these authors state that the addition of 5 per cent protein prevents the deposition of fat which we noted when a diet composed exclusively of sucrose was used. The figures to support this conclusion are not given, unless the authors refer to their diet (*G*) which contained approximately 5 per cent of 'Marmite'. The protein and sucrose diet containing this material is stated to have provided 2 mgm. of choline per rat daily. We would consider this a substantial amount of choline, and quite sufficient to exert an appreciable effect under the conditions of their experiments. The possibility also exists that 'lipotropic' factors other than choline are present in the 'Marmite' preparation.

We would like to suggest that Channon and Wilkinson have emphasised unduly the effect of slight or moderate undernutrition on the deposition of liver fat. They used a diet containing 40 per cent fat and 5 per cent protein, which resulted in an average content of 12·5 per cent liver fat at the end of three weeks. The average gain in weight of the six animals used was 4 gm. It may be pointed out that equally satisfactory increases in weight with diets quite as effective in producing deposition of liver fat have been reported previously. For example, in an experiment in which the effect of betaine was being studied, two groups of animals—19 and 20 rats—showed an average increase in weight of 5 gm. and 7 gm. at the end of three weeks[4]. Furthermore, Best, Channon and Ridout[5] reported two series of rats in which the average gain was 5·7 gm. and 6·9 gm. in twenty-three days. In our experience, slight loss or gain in weight does not exert an appreciable effect on the deposition or disappearance of liver fat, or on the action of choline or other 'lipotropic' substances. This conclusion is well supported by the results in Table II. Twenty rats gained in weight, twelve lost weight slightly, while eight lost a considerable amount. The livers were consistently fatty. We do not believe, therefore, that Channon and Wilkinson were justified in disregarding the results of their experiment in which no protein was provided, and in which the average loss of weight was 19 gm. in three weeks. The average liver fat content was approximately 9 per cent. There would appear to be little, if any, significant difference in the average liver fat obtained in this experiment and in those in which 5 or 10 per cent protein was provided. The fact that the deposition of liver fat is not greater could be attributed, in our opinion, to 'lipotropic' factors contained in the 'Marmite'.

Table II. Duration of Experiment, 21 Days

No. of Rats	Average Change in Weight	Total Fatty Acids of Liver	Diet
	gm.	per cent	per cent
20*	+ 5·4	19·2	Casein 17·8 } Total protein, 21·1 per cent Dried egg white 3·3 }
12†	− 2·6	18·4	Sucrose 35·0 Beef fat 39·3 Salt mixture 4·6 Vitamin A and D concentrate Vitamin B_1 concentrate
8†	− 24·9	19·9	

* All rats gained weight.
† All rats lost weight.

The 'lipotropic' effect of protein should not be underestimated, but in our experience it could be accounted for if the protein contained two or three parts of choline, betaine, or other substances with similar action per 1,000 parts of protein. As we have emphasised previously, protein may exert its 'lipotropic' effect by providing betaine from the metabolism of amino acids, but it is obviously essential to use highly purified proteins or amino acids in investigating this possibility.

We regret that our more recent findings, which appear to us to change, in some degree, the interpretation of their results, were not available to Prof. Channon and Mr. Wilkinson before the publication of their paper. In the circumstances, however, we feel that confusion in the literature will be avoided by the report of these results.

C. H. Best.
M. E. Huntsman.
J. H. Ridout.

Department of Physiology and
The School of Hygiene,
University of Toronto.

[1] C. H. Best, *Lancet*, **226**, 1274; 1934.
[2] C. H. Best and M. E. Huntsman, *J. Physiol.*, **83**, 255; 1935.
[3] H. J. Channon and H. Wilkinson, *Biochem. J.*, **29**, 350; 1935.
[4] C. H. Best, **226**, 1274; 1934.
[5] C. H. Best, H. J. Channon and J. H. Ridout, *J. Physiol.*, **81**, 409; 1934.

Physiology of Whales

Sir Leonard Hill[1] suggests that whales' blood should not become supersaturated with nitrogen since there is not enough air in the lungs. I have observed that Blue and Fin whales spend the vast majority of their lives submerged—at what depth we may never know—and that their sojourns at the surface are usually momentary. The result is that while the decompressed state of the whale lasts only for a few seconds in every ten to twenty minutes, the compressed state predominates. Therefore there is a constant passage of nitrogen into the blood and very little opportunity for it to return into the lungs. Supersaturation is bound to occur if the whale's dive is sufficiently deep.

May I be allowed to advance an *a posteriori* reason for believing that the whale dives deep enough to produce supersaturation of the blood with nitrogen? It lies in the phenomenon of nitrogen removal which occurs in whale blood and to which I have already directed attention[2]. The blood of Blue and Fin whales is capable of so absorbing atmospheric nitrogen that it is not to be regained by evacuation of the blood[3]. It is a most interesting fact that one of the few mammals which might run the risk of caisson sickness is just the one to have a mechanism for avoiding it.

Prof. Krogh has objected[4] that the rate of nitrogen removal shown in my experiments is too low to clear the blood of excess nitrogen quickly enough. The scope of my experiments sufficed only to establish the fact of nitrogen removal and not the rate, which may easily prove to be higher in the blood of living whales or when estimated by a more efficient technique than I was able to use.

In this connexion, I originally suggested that bacteria in the blood were the cause of the nitrogen removal. Further work on whale blood at the London School of Hygiene and Tropical Medicine has failed to support this. The nature of the reaction is not known, except that oxygen is apparently required.

With reference to Dr. Argyll Campbell's suggestion[5] that whales avoid caisson sickness by filling their lungs with water before a dive, I think it may safely be said that this is unlikely since the blast of exhalation is composed only of gases and water vapour. I have just returned from a whale-marking cruise, during which I frequently passed through the column of vapour left by a whale. On one occasion while I was standing in the bows of the whaler, a large Blue whale, about ninety feet long, came up directly beneath the bows and blew in my face. The blast was tremendous and seemed curiously cold, little warmer than the surrounding atmosphere, 5°–6° C. This chilliness is, I imagine, a result of the decompression of air in the whale's lungs. When the whale dives, the air is compressed and produces heat, which is absorbed gradually by the tissues of the lung. During the ascent to the surface the air expands and absorbs heat. The air in its chilly state is discharged before it has time to absorb heat from the lungs and, being saturated with water vapour, appears as a thin mist. This explains why the blast of whales is visible in the tropics where the breath of other mammals is invisible. But only the blasts from whales which have come up from a deep dive will be visible. No decompression cooling will occur in the lungs of whales which did not dive deep and come up again fairly rapidly.

Dr. J. S. Haldane tells me that the same phenomenon occurs in the air lock of caissons, where on decompression the air becomes very cold and supersaturated with moisture. Difficulty is experienced in getting the workers to stay long enough in the lock on account of the chilly discomfort.

Alec H. Laurie.

"Discovery" Investigations,
52 Queen Anne's Chambers,
London, S.W.1.
April 30.

[1] Hill, L., Nature, **135**, 657, April 27, 1935.
[2] Laurie, A. H., Nature, **132**, 135, July 22, 1933.
[3] Laurie, A. H., "Some Aspects of Respiration in Blue and Fin Whales", *Discovery Reports*, **7**, 363–406; 1933.
[4] Krogh, A., "Physiology of the Blue Whale", Nature, **133**, 635; 1934.
[5] Campbell, J. Argyll, Nature, **134**, 629, Oct. 20, 1934.

Osmotic Pressure of Fixing Solutions

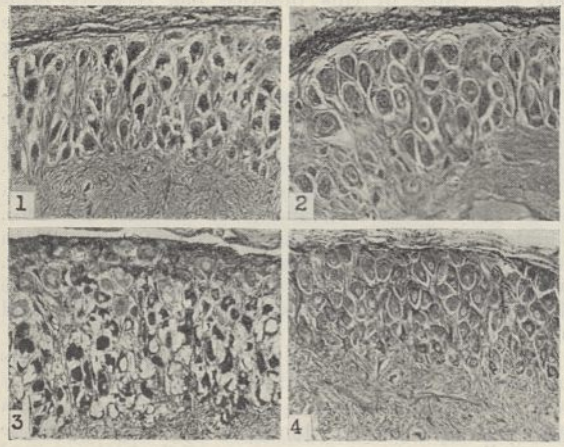
It has long been the custom in many laboratories to make up certain fixatives in saline solutions, but the value of this practice has recently been questioned[1] on the ground that the osmotic pressure of most fixatives, as determined by the freezing point, is already greater than that of the tissues. However, since the particles of the fixative are presumably able to pass more or less freely across the surface membranes of the cells, it seems likely that they do not produce any effective osmotic pressure. If this is so, then the freezing point of a fixing solution is no guide to its 'physiological' osmotic pressure. Further, it is possible that the addition of salts to fixatives is necessary to prevent the distortion which would result from the fact that the particles of fixative differ from those of the tissue fluids in mobility and electrostatic charge.

Since very few critical data exist about the effects produced by fixatives made up in salt solutions[2], it was decided to test the question carefully, using a marine invertebrate in which osmotic effects should be especially conspicuous on account of the high internal concentration of salts. A number of fixatives, both single substances and fixing mixtures, were made up in distilled water and in sea-water, and were then tested as to their effects on the stellate ganglia of *Sepia officinalis*, in which the saline concentration of the blood is close to that of sea water. Each ganglion was cut into two pieces, one of which was fixed in the solution in sea-water, the other in that made up in distilled water. After fixation, the two pieces were transferred to a single receptacle and treated together in all subsequent processes, embedded side by side in paraffin and sectioned in the same block.

It was found that the presence of salts in the fixative is *essential* for good fixation, especially with fixatives which penetrate slowly[3] such as those composed of potassium bichromate, formaldehyde, chromic acid, picric acid or osmium tetroxide. For example, ganglia fixed in 1 per cent chromic acid or 4 per cent formaldehyde in distilled water showed very great distortion, due apparently to swelling and bursting of the cells (Figs. 1 and 2). Similarly, when such fixatives as Champy, Regaud or Flemming without acetic acid were made up in distilled water, they were found to cause bursting of the cells, especially at the centre of the piece, such effects being absent when the same solutions were made up in sea water (Figs. 3 and 4).

With solutions containing mercuric chloride or acetic acid, the difference between the results obtained with solutions made up in distilled and sea water was less marked, being least of all with Bouin's fluid and 'corrosive acetic', though even with these, some distortion could be detected when the fixative was made up in distilled water.

These results confirm the theoretical anticipation that the particles of the fixative do not exert a fully effective osmotic pressure relative to the tissues. One may conjecture that as soon as a piece of tissue is placed in a fixative made up in distilled water, ions begin to diffuse out from the intercellular fluids. Therefore, until the more slowly moving particles of fixative arrive, the cells are effectively in a hypotonic medium, and hence swell and burst. Fixing mixtures generally contain fast-moving ions the value of which is probably that they counteract this effect. However, in many cases the same result can be better achieved simply by the addition of salts. For example, 1 per cent chromic acid in sea water is a really excellent fixative for the nerve cells of *Sepia*.



Nerve cells of *Sepia* in different fixing solutions. (1) 4 per cent formaldehyde in distilled water; (2) the same in sea water. (3) Champy's solution in distilled water; (4) the same in sea water.

When dealing with a marine animal, therefore, all fixatives should be made up in salt solutions similar to those found in the blood of the animal, especially if the fixative is based on formaldehyde, chromic acid, picric acid, potassium dichromate or osmium tetroxide. Further work is now being done to determine to what extent similar considerations apply to the fixation of the tissues of land animals.

J. Z. Young.

Department of Zoology and
Comparative Anatomy,
Oxford.

[1] Baker, "Cytological Technique". London, 1933.
[2] Carleton, *Quart J. Micr. Sci.*, **66**, 501; 1922. Hirsch and Jacobs, *Z. Zellforsch. u. mikr. Anat.*, **3**, 198; 1926. Hertwig, *Z. mikr.-anat. Forsch.*, **23**, 484; 1931.
[3] Underhill, *J. Roy. Micr. Soc.*, **52**, 113; 1932.

Mr. Young has kindly allowed me to study his slides. There is no doubt that he has proved his point, and that the conclusions that I have drawn about the osmotic pressures of fixatives in my book "Cytological Technique" are erroneous.

John R. Baker.

Chinese Influence on Western Alchemy

In his very able reconstruction of the origin and development of Western alchemy, Prof. A. J. Hopkins[1] does not discuss the possible influence of Chinese ideas as the seed which may have served to crystallise alchemical philosophy in Alexandria "somewhat after the beginning of the Christian era". He presents the origin of Egyptian alchemy as a perfectly logical and highly successful application of Platonic-Aristotelian philosophy to the apparently miraculous colour changes effected by the Egyptian craftsman in his closely allied arts of dyeing fabrics and colouring metals.

Existing data[2] show that alchemical practices were common in China probably several centuries before they appeared in Egypt, and the suggestion has been made that the Western art possibly owes its inspiration to the former. It thus becomes a matter of some interest to determine whether such a possibility is compatible with Prof. Hopkins's thesis.

Chinese alchemy[2] was concerned primarily with the twin pursuits of immortality and transmutation. In each case the goal was to be reached by changing the base, heavy, coarse, gross, material, undesirable, etc. (that is, *Yin*), qualities of man or metal into the opposite noble, light, fine, ethereal, spiritual, desirable, etc. (that is, *Yang*), attributes. The underlying philosophy regarding why and how this could be accomplished was closely linked with Taoism and the search for the *Tao*, but one gains the impression that Taoism was much more inextricably intermingled with efforts towards longevity and immortality of man than with those towards the transmutation of metals. Continuous life (that is, with no intervening death and bodily dissolution) involved bringing man into conformity with *Tao* through the conversion of his *Yin* (material, corruptible) nature into the *Yang* (spiritual, incorruptible, *Tao*). Some assumed knowledge of Taoism, therefore, would appear to have been pre-requisite for any hope of success, including at least a working hypothesis regarding the spiritual part of man. On the other hand, in the case of the transmutation of metals as a means to mundane riches or position (that is, when not too closely associated with the idea of immortality and the life-prolonging 'elixir'), attention appears to have been centred more closely on the contraries, *Yin* and *Yang*.

It is interesting to speculate on the reception in Alexandria which might have been accorded to marvellous tales of immortality and transmutation carried thither along the trade routes from China. It seems probable that stories of immortality, of "the drug which prevents death", of the *hsien* or 'immortals' would have been listened to with incredulity. Since the *Tao* was not comprehended in China, in what a garbled and unintelligible form would Taoism have been discussed in Alexandria—if indeed its very abstruseness would not have prevented any such discussion. Furthermore, the Alexandrian had no personal evidence of immortality in the Chinese alchemical sense, and he already possessed several alternative hypotheses regarding the spirit and soul of man. But the fact that the early centuries of Western alchemy are free from the illusion of immortality, whereas this aspect was the earliest and always the most important feature in China, does not necessarily disprove a Chinese influence on the origin of alchemy in Egypt. Accounts of

transmutation, however, could have been received with enthusiasm. The two contraries (*Yin* and *Yang*) might have been identified with the opposing Greek 'elements' of *water* and *fire* and hence with the two 'qualities' of *mercury* and *sulphur*. No understanding of *Taoism* would have been necessary. The fact that transmutation was alleged to have been accomplished by changing lower qualities or natures into higher ones might have been sufficient to arouse interest, particularly in the mind of the Egyptian artisan who was daily confronted in his workshop with curious and striking changes in the appearance (notably colour) of metals under suitable treatment. Consequently, may not the alleged fact of the practical transmutation of the metals in China as related by traders in Alexandria have been the inspiration for that marriage of Greek philosophy and Egyptian craftsmanship which Prof. Hopkins believes gave birth to Western alchemy ?

The purpose of this note is to indicate that the apparent completeness of Prof. Hopkins's picture does not automatically preclude the possibility that reports of Chinese alchemy may have had some influence on the origin of the Egyptian art. Whether such an influence is considered to be 'improbable' or 'probable', present data still appear to indicate that it is 'possible'.

William H. Barnes.

Department of Chemistry,
McGill University,
Montreal.
March 1.

[1] Hopkins, A. J., "Alchemy : Child of Greek Philosophy", Columbia Univ. Press, New York ; 1934 ; *Isis*, **7**, 58–76 ; 1925.
[2] Barnes, W. H., *J. Chem. Ed.*, **11**, 655–658 ; 1934. Davis, T. L., *J. Chem. Ed.*, **11**, 517–620, 635 ; 1934 : **12**, 1, 51 ; 1935. Davis, T. L. and Wu, L. C., *Sci. Monthly*, **31**, 225–235 ; 1930 : *J. Chem. Ed.*, **9**, 859–862 ; 1932 ; *Isis*, **18**, 210–289 ; 1932. Edkins, J., *Trans. China Branch, Roy. Asiatic Soc.*, Hong Kong, pt. 5, 83–89 ; 1855. Forke, A., *Archiv. Gesch. Philosophie*, **41**, 115–126 ; 1932. Johnson, O. S., "A Study of Chinese Alchemy", Commercial Press, Shanghai ; 1928. Martin, W. A. P., "The Lore of Cathay", Chap. iii, "Alchemy in China", pp. 44–71, Fleming H. Revell Co., New York, Chicago, Toronto ; 1901. Partington, J. R., Nature, **119**, 11 ; 1927 : **120**, 158 ; 1927. Read, B. E., Nature, **120**, 877 ; 1927. Waley, A., *Bull. Sch. Orient. Studies*, **6**, 1–24, 1102–3 ; 1930–32.

The Ratio 136/137 in Atomic Physics

In an earlier letter[1] I suggested that some (or all) of the determinations of the specific electronic charge, e/m, disagreed with the value deduced from Sir Arthur Eddington's $M/m = 1847{\cdot}6$ theory (namely, $1{\cdot}7703 \times 10^7$ e.m.u.) because they were really measurements of

$$\frac{136}{137}(1{\cdot}770{,}3_1 \pm 0{\cdot}000{,}1_4) \times 10^7 = (1{\cdot}757{,}4 \pm 0{\cdot}000{,}14) \times 10^7 \text{ e.m.u.}$$

Prof. Birge[2] stated that the measurements agreed with my hypothesis even better than I had suggested ; and Sir Arthur Eddington[3] suggested that, on theoretical grounds, the ratio would be expected to be very nearly 136/137.

The hypothesis can now be tested with precision. The seven most recent determinations[4] of e/m are :

1·757,9	± 0·002,5	× 10^7 e.m.u.
1·758,7	± 0·000,9	
1·757	± 0·001,5	
1·758		
1·757	± 0·001	
1·757,0	± 0·001,0	
1·757,9	± 0·000,3	

The unweighted mean of these seven :

$$(1{\cdot}757{,}6_4 \pm 0{\cdot}000{,}2) \times 10^7 \text{ e.m.u.},$$

may be compared with the value given by my hypothesis :

$$(1{\cdot}757{,}4 \pm 0{\cdot}000{,}14) \times 10^7 \text{ e.m.u.}$$

Apparently the factor 136/137 is involved because we analyse a system, such as an atom, into 'separate parts' which 'interact'. It seems that the effective mass of the less massive portion may have one of two distinct values according to our point of view.

Prof. Birge[5] has pointed out that the estimate of the electronic charge deduced from Millikan's experiment ($4{\cdot}768 \times 10^{-10}$ e.s.u.) and the estimate obtained by the crystal-grating X-ray method ($4{\cdot}803 \times 10^{-10}$) are almost in the ratio 136/137. I wish to make a rather similar suggestion.

I have formerly[6] given evidence that Sir Arthur Eddington's theoretical deductions $hc/2\pi e^2 = 137$ and $M/m = 1847{\cdot}6$ are true. From these (with the help of Faraday's and Rydberg's constants) we can deduce[7] what I believe to be the most reliable estimate of e, namely :

$$(4{\cdot}775{,}9 \pm 0{\cdot}000{,}4_3) \times 10^{-10} \text{ e.s.u.}$$

I would suggest that the crystal-grating X-ray estimate of e is really an estimate of

$$\frac{137}{136}(4{\cdot}775{,}9 \pm 0{\cdot}000{,}4_3) \times 10^{-10} = (4{\cdot}810{,}9 \pm 0{\cdot}000{,}4_3) \times 10^{-10} \text{ e.s.u.}$$

This value could also be obtained by assuming $hc/2\pi e^2 = 137$, but using $e/m = 1{\cdot}757_4$ in the Rydberg-Bohr equation.

The most recent determinations of e by the X-ray method[8,9] give the values $4{\cdot}806 \pm 0{\cdot}003$ and $4{\cdot}805$, which are in reasonably good accord with the $4{\cdot}810_9$ suggested above. Ruark[10] finds that certain discrepancies disappear if he uses $e = 4{\cdot}806 \pm 0{\cdot}003$, $e/m = 1{\cdot}757{,}9 \pm 0{\cdot}0003$, $hc/2\pi e^2 = 137{\cdot}04$.

If this second hypothesis of mine is correct, it would appear that the discrepancy between the two methods of estimating the electronic charge (or the two methods of estimating the X-ray wave-lengths) is due to the faulty analysis of a 'system' into two 'parts'. I do not know where the error occurs. It may be due to our assuming that '*the* mass' contained in each unit cell in a crystal can be deduced by multiplying 'the volume' of the unit cell by the density of the crystal. We naïvely contemplate the system as split up into parts.

W. N. Bond.

Department of Physics,
University of Reading.
March 8.

[1] W. N. Bond, Nature, **133**, 327 ; 1934.
[2] R. T. Birge, Nature, **133**, 648 ; 1934.
[3] A. S. Eddington, Nature, **133**, 907 ; 1934.
[4] C. D. Shane and F. H. Spedding, *Phys. Rev.*, **47**, 33 ; 1935.
[5] R. T. Birge, *loc. ci* .
[6] W. N. Bond, *Proc. Phys. Soc.*, **44**, 374 ; 1932.
[7] R. T. Birge, *Phys. Rev.*, **40**, 319 ; 1932. (Prof. Birge amended my calculation of e, but owing to a numerical mistake he obtained too small a value for the probable error, namely, ± 0·000,048 in place of ± 0·000,4₃.)
[8] E. Bäcklin, Nature, **135**, 32, Jan. 5, 1935.
[9] M. Söderman, Nature, **135**, 67, Jan. 12, 1935.
[10] A. E. Ruark, *Phys. Rev.*, **47**, 316 ; 1935.

Auger Effect and Forbidden Transitions

It is well known that after an atom has been ionised, for example in its K shell, the ensuing reorganisation of the extra-nuclear electronic structure is not by any means invariably accompanied by the emission of K-radiation. Quite frequently we have instead a 'radiationless' change of the type first completely specified by Rosseland, which results in the expulsion of a 'photo-electron of the second kind' and in leaving the atom doubly ionised—until further reorganisation occurs—in its X-ray levels. These photo-electrons of the second kind were observed by M. de Broglie, but the manner in which they originate was first clearly established by Auger's beautiful work with the Wilson cloud chamber, and it is convenient and not inappropriate to refer to them as Auger electrons.

In a recent very interesting paper[1], Mr. E. H. S. Burhop has calculated, by the methods of quantum mechanics, the relative probabilities of emission of different types of Auger electrons—that is, corresponding to different types of radiationless switches—from atoms initially ionised in the K shell. The Auger electrons resulting from interactions between the L shells fall into six sets, which may be classified thus :

(*a*) $L_{\mathrm{I}}, L_{\mathrm{I}} \rightarrow K,\infty$	(*d*) $L_{\mathrm{II}}, L_{\mathrm{II}} \rightarrow K,\infty$
(*b*) $L_{\mathrm{I}}, L_{\mathrm{II}}, \rightarrow K,\infty$	(*e*) $L_{\mathrm{II}}, L_{\mathrm{III}} \rightarrow K,\infty$
(*c*) $L_{\mathrm{I}}, L_{\mathrm{III}} \rightarrow K,\infty$	(*f*) $L_{\mathrm{III}}, L_{\mathrm{III}} \rightarrow K,\infty$,

the first two symbols indicating the electrons taking part in the disturbance, and the last two their immediate destinations—∞ being an obviously convenient symbol for 'outside the atom'.

Of the six sets, those in (*a*) will have the lowest energy; (*b*) and (*c*) will have approximately equal energies, appreciably greater than (*a*), and a similar thing is true of the fastest sets, (*d*), (*e*) and (*f*). An instrument of moderate resolving power would therefore (at least for light and moderately light atoms) record these six sets of Auger electrons as three groups, namely, I, set (*a*); II, sets (*b*) and (*c*); III, sets (*d*), (*e*) and (*f*). According to Burhop's calculations for element 47 (silver), the relative numbers of electrons in these three groups should be approximately in the proportion 1 : 3·4 : 6·7.

Electrons of Groups II and III were in fact recorded, with about the right relative intensities, by Robinson and Cassie[2] in a paper published in 1926 and quoted by Burhop. The less intense Group I was not observed in the 1926 experiments, but as its appearance—or non-appearance—is a matter of rather special interest, I wish now to point out that it was recorded in some later experiments of Robinson and Young[3], which have been overlooked by Mr. Burhop.

The special interest attached to this particular group lies in the fact that $L_{\mathrm{I}} \rightarrow K$ is a forbidden transition in the X-ray spectral series scheme ($\Delta l = 0$, in the *nlj* notation for levels). Its appearance in our experiments and in the β-ray spectra of Ellis establishes experimentally a fundamental difference between the elementary processes which constitute the Auger effect, and the only alternative set of processes which could be invoked to explain the occurrence of photo-electrons of the second kind, namely, the production and internal absorption of the characteristic X-radiation of the atom.

In our experiments of 1930, the Auger electrons of Group I were not very clearly photographed. Since then, in the course of work on a different problem, and using an improved photographic technique, I have occasionally obtained very much better records of Auger electrons. One particularly good example may be quoted here, as it has not previously been published. The element under examination was copper (29); the velocities of the electrons are deduced from deflections in a magnetic field, and expressed[4] in terms of (rH) gauss cm. These are converted into equivalent frequencies (ν/R in Rydberg units) by the use of known constants, and hence by comparison with X-ray data the level of origin of the electron can be deduced with certainty.

Relative Intensity	rH	ν/R	Type of Electron
1	$277{\cdot}4_9$	495·9	Group I
5	$280{\cdot}4_3$	506·7	Group II
8	$283{\cdot}7_7$	518·8	Group III

The agreement with the theory is striking. I think I should add that my own sense of satisfaction with the results is if anything enhanced by the feeling that it may be slightly unmerited; the approximations made in the quantum mechanical theory and—not less—the necessary latitude in my estimates of relative intensities, might well account for differences between experiment and theory appreciably greater than those recorded above. The general nature of the experimental results, however, leaves no room for reasonable doubt of the essential accuracy of the quantum mechanical methods which have been applied to the problem.

H. R. Robinson.

Queen Mary College,
University of London.
March 13.

[1] Burhop, E. H. S., *Proc. Roy. Soc.*, A, **148**, 272, February 1935.
[2] Robinson and Cassie, *Proc. Roy. Soc.*, A, **113**, 282; 1926.
[3] Robinson and Young, *Proc. Roy. Soc.*, A, **128**, 92; 1930.
[4] cf. Robinson and Cassie or Robinson and Young, *loc. cit.*

Supra-conducting Alloys

The behaviour of supra-conducting alloys has been found[1] to be different from that of pure metals in two ways :

(1) The magnetic induction (B) in alloys does not change to zero when they become supra-conducting.

(2) A supra-conducting alloy shows no discontinuity in the specific heat of such an order as would be expected according to Rutgers' formula[2].

These phenomena seem to be well established, as more recent experiments by de Haas and Casimir[3] and Tarr and Wilhelm[4] are in agreement with (1), while Shubnikow and Chotkewitsch[5] succeeded quite recently in confirming our result (2).

We measured the permeability of the same alloy the specific heat of which we determined and found that magnetic flux could penetrate it at much lower fields than the threshold values of supra-conductivity (compare ref. 3). That means that the condition $B = 0$ on which Gorter's[6] thermodynamical treatment is based is not entirely fulfilled in supra-conducting alloys and therefore Rutgers' formula must not be applied. In order to investigate the supra-conducting region where $B \neq 0$ (shaded, Fig. 1), we determined the change of induction which corresponds to a small change $\triangle H$ in the external field between T_1 and T_2 in rods of $Pb_{30\%}$ $Bi_{70\%}$. Curve 1 is the threshold curve from a very similar alloy[7], while curve 2 indicates the field strengths at which flux first penetrated the alloy.

(*a*) When the specimens were cooled previously in zero field, no change of induction was observed below curve 2. After passing curve 2, flux entered the alloy when switching on $\triangle H$ but no flux left when switching off. This continued until near curve 1 the changes became reversible and finally normal after passing curve 1.

(*b*) On cooling to T_1 in H_1, no changes were observed below the reversible region near curve 1 for switching on or off $\triangle H$.

(*c*) Warming up again to T_2 gave the same result as in (*b*).

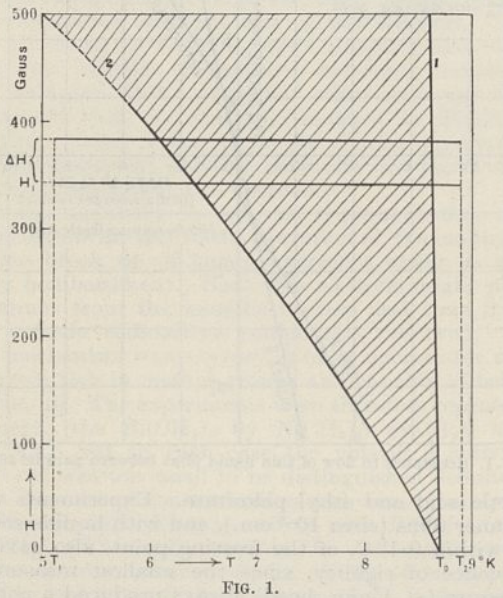


FIG. 1.

A possible explanation for all these phenomena is that the threshold value is high in some parts of the alloy while the main part has about the same value as pure metals. Such a model would act like a fine supra-conducting sponge the meshes of which are formed by annular regions of high threshold value impenetrable for magnetic flux that has once been caught in them. If the alloy is cooled in an external field, the sponge becomes supra-conducting first and the induction inside the meshes cannot change to zero (1). As the main part of the alloy has a low threshold value, this will cause only a very small discontinuity in the specific heat (2). Finally, this explanation conforms with the experiments (*a*) to (*c*). In (*a*), at first there is zero induction inside the meshes and no lines of force can enter the alloy. After passing curve 2, some meshes of the sponge break down whenever the field is increased and magnetic flux enters them. On switching off $\triangle H$, however, this flux is not pressed out again as the material inside the meshes is no longer supra-conducting in this region of the H, T-diagram. This filling up with magnetic flux continues until near the threshold curve all changes of flux become reversible. In (*b*) and (*c*) the meshes already enclose lines of force in the normal state which are 'frozen' in as soon as the sponge becomes supra-conducting (1), and from now on no flux enters or leaves the sponge until finally curve 1 is reached again.

The question arises whether the skeleton of such a sponge of high threshold value is a supra-conductor of zero induction, or if the meshes are formed by supra-conducting regions the thickness of which is of the order of the penetration depth of currents in supra-conductors[8] or even of atomic dimensions, for both of which the description of supra-conductivity by zero induction has lost its significance. Further, it is not yet clear if such a sponge has the same high threshold value throughout, or if it consists of meshes of all threshold values between curves 1 and 2, so that the supra-conducting cross-section gradually increases with decreasing temperature. Results similar to those in alloys have been obtained on fairly pure (90–99 per cent) tantalum. For tantalum the steepness of curve 1 was found to be about 1,500 gauss/degree while that of curve 2 was 650 gauss/degree.

A detailed account of these results will be published elsewhere.

K. MENDELSSOHN.
JUDITH R. MOORE.

Clarendon Laboratory,
Oxford.
April 3.

[1] T. C. Keeley, K. Mendelssohn, J. R. Moore, NATURE, **134**, 773; 1934.
[2] A. J. Rutgers, *Physica*, **1**, 1055; 1934.
[3] W. J. de Haas and J. M. Casimir-Jonker, NATURE, **135**, 30, Jan. 5, 1935.
[4] F. G. A. Tarr and J. O. Wilhelm, *Can. J. Res.*, **12**, 265; 1935.
[5] L. W. Shubnikow and W. J. Chotkewitsch, *Phys. Sow.*, **6**, 606; 1935.
[6] C. J. Gorter and H. Casimir, *Physica*, **1**, 305; 1934.
[7] *Comm. Leiden*, 214*b*.
[8] Becker, Heller and Sauter, *Z. Phys.*, **85**, 772; 1933. H. London, NATURE, **133**, 497; 1934.

Electrical Resistance of Pure Aluminium at Liquid Helium Temperatures

THE electrical resistance of aluminium at liquid helium temperatures has been investigated by Tuyn and Kamerlingh Onnes[1], by Meissner and Voigt[2], and by Keesom[3], who discovered that this metal becomes supra-conducting at about 1·14° K. The measurements of Meissner and Voigt appear to show that the resistance of aluminium in the liquid helium region between 4·2° and 1·3° K. is not constant, but increases slightly with decreasing temperature. On the other hand, Tuyn and Kamerlingh Onnes, as well as Keesom, have found that the resistance is constant in this region, but examination of their data shows that the residual resistance of their specimens was larger than those of Meissner and Voigt. A slight increase of resistance at liquid helium temperatures has also been reported for molybdenum, cobalt and magnesium[2], and recently for gold[4]. Since such a phenomenon is of considerable theoretical interest, and since we had at our disposal some samples of very pure aluminium, we have made further measurements on the resistance of this metal at liquid helium temperatures.

The aluminium used in our investigation was supplied by the British Aluminium Co., and was specified to be at least 99·995 per cent pure. It was drawn in this laboratory into wires of 0·15 mm. diameter. Spectrographic analysis of the metal, taken before and after drawing, showed only minute impurities due to magnesium, calcium and perhaps copper. Four specimens varying in length from 68 cm. to 86 cm. were selected from the wires; these are hereafter designated as Nos. 3, 4, 5 and 6. Specimens 5 and 6 were annealed for 3 hours in high vacuum at 250° C., and No. 4 at 275° C.; specimen 3 was not annealed. The values of $R_T/R_{0°C.}$, calculated from the measured resistance of these wires at the temperatures indicated, are plotted in the accompanying graphs (Fig. 1, see over).

As seen from the graphs, the curves which best fit our values of $R_T/R_{0°C.}$ are straight lines parallel to the temperature axis. The absolute experimental error in the ratios we estimate as not greater than 0·00002. According to the data of Meissner and Voigt, we should expect an increase in $R_T/R_{0°C.}$ of between 0·00007 and 0·00014 in the temperature interval 4·2° to 2·2° K. Since Nos. 5 and 6 show smaller values of $R_T/R_{0°C.}$ in this region than any previously reported for aluminium, we conclude that, within the accuracy of our measurements, there is no increase in the resistance of pure aluminium down to 2·2° K.

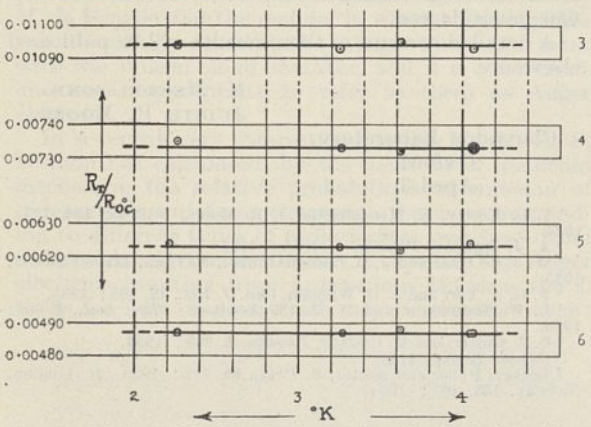


FIG. 1. Relation of $R_T/R_{0°C.}$ to temperature for aluminium at low temperature.

The liquid helium for these experiments was produced by the new helium liquefier designed by Prof. P. Kapitza[5]. A detailed report of these experiments will appear elsewhere.

H. A. BOORSE.
H. NIEWODNICZAŃSKI.

Royal Society Mond Laboratory,
Cambridge. April 23.

[1] *Leiden Comm.*, No. 181; 1926.
[2] *Ann. Phys.*, **7**, 761; 1930.
[3] *Leiden Comm.*, No. 224c; 1933.
[4] W. J. de Haas, J. de Boer and G. J. van den Berg, *Physica*, 1, 1115; 1934.
[5] *Proc. Roy. Soc.*, A, **147**, 189; 1934.

Range of Action of Surface Forces

IN a recent letter, Wilsdon, Bonnel and Nottage[1] suggest that anomalies observed in the vapour pressure, osmotic pressure and flow of water in porous materials and in capillaries are due to oriented chains of water molecules extending to a distance of 50×10^{-5} cm. from the surface. The possibility of such a structure has been suggested by Hardy[2], and by Watson and Menon[3], who found that a polished plate floated in air or water at a height of 40×10^{-5} cm. from a parallel plate. Further experiments[4], however, carried out at Sir William Hardy's suggestion showed that the separation of the plates was due to dust or to some similar commonplace cause.

More recently, Derjaguin[5], from observations on the resistance offered by water to the movement of an oscillating lens, concluded that a water film 1×10^{-5} cm. thick has a rigidity about 1/300 of that of solid lead. We have measured the resistance offered to the flow of thin liquid films enclosed between parallel surfaces. A relatively thick film (60×10^{-5} cm.) of a 1 per cent solution of ammonium oleate in water (a liquid crystal known to possess a slight bulk rigidity) gave the results shown in Fig. 1 (Curve 1), a pressure head of about 2 cm. being required to cause appreciable flow.

A water film, 16×10^{-5} cm. thick, gave Curve II, which is linear and passes through the origin. Similar results were obtained with alcohol, cyclohexane,

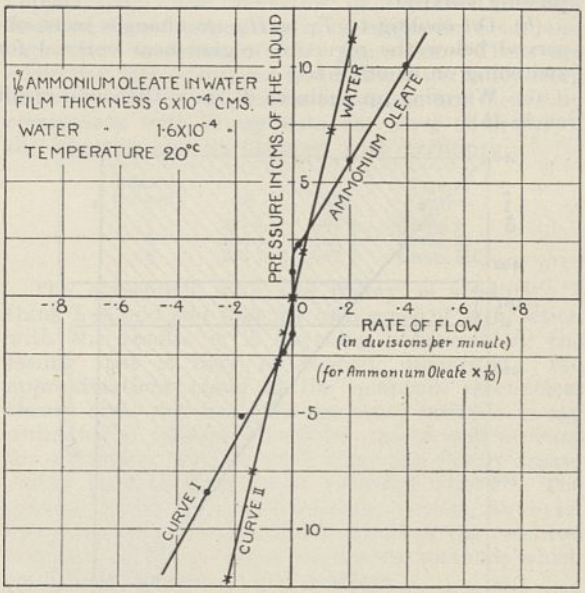


FIG. 1. Resistance to flow of thin liquid films between parallel surfaces.

acetic acid and ethyl palmitate. Experiments with thinner films (*circa* 10^{-5} cm.), and with liquids cooled to within 0·1° C. of the freezing point, also gave no evidence of rigidity, since the smallest measurable pressure (< 1 mm. head) always produced a normal flow and within the accuracy of the measurements, *the viscosity of the film was the same as that of the liquid in bulk.*

The mechanical properties of the first few molecular layers of an adsorbed gas or liquid may be profoundly modified by the solid surface, but no such effects can be detected at distances of 10^{-5} cm. and the extension of rigid chains to a distance of 50×10^{-5} cm. seems quite out of the question.

F. P. BOWDEN.
S. H. BASTOW.

Laboratory of Physical Chemistry,
Cambridge. March 12.

[1] Wilsdon, Bonnel and Nottage, NATURE, **135**, 186, Feb. 2, 1935.
[2] Hardy, *Phil. Trans. Roy. Soc.*, A, **230**, 1; 1932.
[3] Watson and Menon, *Proc. Roy. Soc.*, A, **118**, 211 1928.
[4] Bastow and Bowden, *Proc. Roy. Soc.*, A, **134**, 404; 1931.
[5] Derjaguin, *Z. Phys.*, **84**, 657; 1933.

Interchange of Heavy Atoms in Organo-Metallic Methyls

USING the radioactive indicator method in which radioactive isotopes are used to indicate transference of atoms, we have obtained evidence which suggests that both lead and bismuth, deposited, presumably as oxides, on a metallic surface, can exchange with lead in lead tetra-methyl and bismuth in $Bi(CH_3)_3$ in ether solution at room temperature.

For bismuth the radioactive isotopes radium E and thorium C, periods 5 days and 60·5 minutes respectively, were used, and for lead, ThB with period 10·6 hours was employed.

The following experiment is typical: A piece of gold is activated with Th(B + C + C′ + C″) by exposure to thoron in the usual way. The gold is immersed in a solution of $Bi(CH_3)_3$ in ether for two hours. Then a small quantity of the solution is introduced into a small pot inside a Wilson expansion chamber filled with nitrogen. The solution evaporates from the pot, and eventually the $Bi(CH_3)_3$ settles on the boundaries of the chamber, perhaps oxidised by traces of oxygen. The characteristic α-tracks of Th(C + C′) are observed starting from parts of the chamber remote from the pot, thus proving that a volatile compound of ThC has been formed which has evaporated with the rest of the solution. The rate of decay of these α-tracks supports the view that the volatile radioactive substance contains ThC and not ThB. A similar effect is found if a source of RaE on nickel is inserted in $Bi(CH_3)_3$ solution. After a few days the shorter α-particles of the subsequent element polonium are found distributed throughout the chamber.

It was necessary to test the hypothesis that the above effects are due to the liberation of 'free methyls' by the break up of heavy molecules under α- and β-ray bombardment. Such free methyls might pick up atoms from the metallic surface and thus form the volatile radioactive compounds observed. If this mechanism were correct, it must operate for any molecule rich in methyl groups and capable of being broken up. The experiments were therefore repeated, replacing the $Bi(CH_3)_3$ by $N(CH_3)_3$, $Si(CH_3)_4$ and $Sn(CH_3)_4$, but in each case the volatile α-activity observed was too small to be distinguished definitely from the normal contamination and was certainly of a different order from the effect with $Bi(CH_3)_3$ and $Pb(CH_3)_4$. This indicates that the exchange process occurs mainly between atoms of the same atomic number and without the break up of the molecule.

With $Pb(CH_3)_4$ and Th(B + C + C′ + C″) the effect is remarkable in that the unmistakable α-emission of Th(C + C′) is observed immediately evaporation begins, and photographs showing these α-particles starting in the gas have been obtained. This indicates the unexpected presence of a volatile bismuth compound. On the other hand, the rate of decay of the activity in the chamber is consistent with the ten-hour period of ThB, which must therefore have distilled over with the ThC. This may be explained if the oxidation of $Bi(CH_3)_3$ is inhibited or retarded in the $Pb(CH_3)_4$ solution, which will therefore contain equilibrium amounts of $ThC(CH_3)_3$ and $ThB(CH_3)_4$ which will evaporate together.

Measurements of the rate of interchange are in progress using an ionisation method and also a tube counter system constructed by Miss E. E. Widdowson, whom we wish to thank, together with Prof. Arthur Ellis, who kindly gave us some old radon tubes.

ALICE LEIGH-SMITH.
King's College, London, W.C.2.

H. O. W. RICHARDSON.
Bedford College, London, N.W.1.

Ebulliometric Determination of the Degree of Decomposition of an Organic Substance

IN previous papers it has been shown that the application of an ebulliometer with several dephlegmators[1] (Fig. 1) filled with an azeotropic mixture of benzene and ethanol or any other binary mixture forming with water a ternary azeotrope, enables one to determine with an accuracy up to 0·001 per cent the quantity of moisture in solid organic substances soluble in the above-mentioned azeotrope. The same method can be applied for determinations of the degree of decomposition of organic substances forming water as one of the products of decomposition.

Let us suppose that the decomposition of succinic acid by heating to the temperature t is examined. For this purpose a certain quantity of this acid is placed in a test-tube which is afterwards closed like a Carius tube. After heating for a certain time at the given temperature, the tube is carefully shaken and the substance is brought to the vessel A of the ebulliometer, which is filled with azeotropic mixture of benzene and ethanol. The water formed by the decomposition of succinic acid forms a ternary system (azeotropic mixture) with benzene and ethanol, which has a lower boiling point than the mixture of benzene and ethanol. Noting the lowering of the condensation temperature in the upper part of the ebulliometer (the thermometer is placed in the uppermost test-tube of the apparatus), it is possible to calculate the quantity of water formed, after carrying out a direct determination of the lowering of temperature per milligram of water, introduced into the ebulliometer. The heating of the reflux tubes by microburners must be so regulated that the number of drops flowing through the drop-counters F, F_1, F_2, F_3 is approximately the same in both experiments.

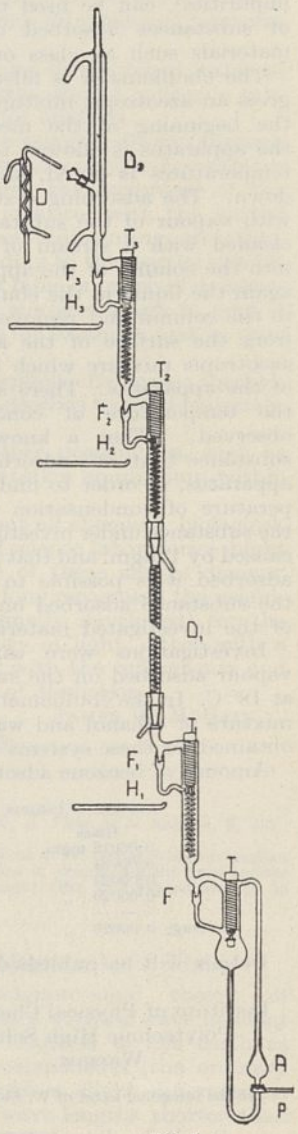


FIG. 1.

The method makes it possible to determine the formation of 0·001 per cent of water by the decomposition of substances. Details will be published elsewhere.

W. SWIETOSŁAWSKI.

Institute of Physical Chemistry,
Polytechnic High School,
Warsaw.

[1] W. Swietosławski, *Chemické listy*, **26**, 772; 1932. Conferencias de Introduccion de IX Congresso International de Quimica Pura Y Aplicada, Madrid, 5–11 April, 1934, p. 9.

Ebulliometric Method of Determining the Amount of a Substance Adsorbed on the Surface of Solid Substances

EBULLIOMETRIC apparatus with a few dephlegmators constructed by W. Swietosławski, applied to the determination of very small quantities of impurities[1], can be used to investigate the amount of substances adsorbed on the surfaces of solid materials such as glass or metals.

The ebulliometer is filled with a substance which gives an azeotropic mixture with that adsorbed. At the beginning of the measurement, the liquid in the apparatus is allowed to boil, the distribution of temperatures is noted, and afterwards it is cooled down. The adsorbing system is placed in the tube with vapour of the substance to be adsorbed, then cleaned with a stream of dry air, and introduced into the column of the apparatus. After heating up again the liquid in the ebulliometer, its vapour flows to the column and removes the adsorbed substance from the surface of the adsorbent, and forms the azeotropic mixture which rises to the upper section of the apparatus. There a considerable lowering of the temperature of condensation of vapours is observed. Then a known amount of the same substance that was adsorbed is introduced into the apparatus, in order to find the lowering of the temperature of condensation produced by 1 mgm. of the substance under investigation. From the lowering caused by 1 mgm. and that produced by the substance adsorbed it is possible to calculate the amount of the substance adsorbed on 1 sq. cm. of the surface of the investigated materials.

Investigations were carried out with benzene vapour adsorbed on the surface of glass and copper at 18° C. In the ebulliometer there was an azeotropic mixture of ethanol and water. The numerical data obtained for these systems are as follows :

Amount of benzene adsorbed on 1 cm.^{2} at 18° C.

Amount of benzene adsorbed on 1 cm.^{2}.

Glass	Copper
0·00019 mgm.	0·00026 mgm.
0·00034 ,,	0·00052 ,,
0·00023 ,,	0·00022 ,,
0·00029 ,,	0·00035 ,,
Average 0·00026 ,,	Average 0·00034 ,,

Details will be published shortly.

M. WOJCIECHOWSKI.
Institute of Physical Chemistry,
Polytechnic High School,
Warsaw.

[1] See the foregoing letter of W. Swietosławski.

Compressibility of Electrolytic Solutions

THE adiabatic compressibilities of some strong electrolytes have been measured as a function of the molar concentration c by means of a new optical method, which has been developed in the Department of Electrolytic Research of the University of Cologne. It was found that the linear dependence of the apparent molal compressibility on the square root of the concentration is valid (within the experimental error of 0·1 per thousand), also in dilute solutions, even in solutions ten times more dilute than those on which Gucker[1] based his calculations.

The limiting slopes derived from the interionic attraction theory by Gucker agree with our new experimental results only for the 1-1- and 1-2-valent salts, whereas in the case of electrolytes of higher valency a smaller slope was measured than that expected by theory. Different electrolytes of the same valency type show individual characteristics, a fact which Gucker was the first to point out[2].

The compressibility, k, as a function of c is given by the following relation : $k = Ac + Bc^{3/2}$. Gucker supposed that the apparent molal compressibility of non-electrolytes is also governed by the square root law with respect to c. This was not confirmed by our new measurements on cane sugar. We intend to make a further improvement in the experimental method by determining the middle of the nodal lines by a photometric method. It will then be possible to reach the region which is of special interest for the interionic attraction theory. Many other problems will be of great interest : for example, the effect of dielectric constant or temperature upon the compressibility.

A detailed account of the work will be published soon by one of us.

H. FALKENHAGEN.
CH. BACHEM.
Abteilung für Elektrolytforschung am
Physikalischen Institut der Universität,
Köln.
March 29.

[1] F. T. Gucker, *J. Amer. Chem. Soc.*, **55**, 2709 ; 1933. *Chem. Rev.*, **13**, 111 ; 1933.

[2] The theory by La Mer, Gronwall, Sandved may be able to give an explanation of this behaviour. See Falkenhagen's monograph on "Electrolytes", Clarendon Press, Oxford, 1934.

Mathematical Psychology of War

AS NATURE has encouraged scientific workers to think about public affairs, I beg space to remark that equations, describing the onset of the War, and published under the above title* in 1919, have again a topical interest, in connexion with the present regrettable rearmament. In revised form :

$$\frac{dx_1}{dt} = k_{12}.x_2 - \gamma_1 x_1 + \triangle_1 ;$$

$$\frac{dx_2}{dt} = k_{21}.x_1 - \gamma_2 x_2 + \triangle_2.$$

The suffixes 1 and 2 refer to the opposing nations, or groups of nations. The symbol x denotes the variable preparedness for war ; t is the time ; k is a 'defence-coefficient' and is positive and more or less constant ; γ is a 'fatigue and expense' coefficient and is also positive and moderately constant. Lastly, $\triangle$ represents those dissatisfactions-with-treaties, which tend to provoke a breach of the peace.

If $\triangle_1$, $\triangle_2$, x_1, x_2 could all have been made zero simultaneously, the equations show that x_1 and x_2 would have remained zero. That ideal condition would have been permanent peace by disarmament-and-satisfaction. The equations further imply that mutual disarmament without satisfaction is not permanent, for if x_1 and x_2 instantaneously vanish, $dx_1/dt = \triangle_1$ and $dx_2/dt = \triangle_2$.

Unilateral disarmament corresponds to putting $x_2 = 0$ at a certain instant. We have at that time :

$$\frac{dx_1}{dt} = -\gamma_1 x_1 + \triangle_1 ;$$

$$\frac{dx_2}{dt} = k_{21}.x_1 + \triangle_2.$$

* Obtainable from Geneva Research Center, 2 Place Chateaubriand, Geneva, price 5s. post paid. Few copies remain.

The second of these equations implies that x_2 will not remain zero ; later, when x_2 has grown, the term $k_{12}.x_2$ will cause x_1 to grow also. So unilateral disarmament is not permanent, as Germany has shown us

A race in armaments, such as was in progress in 1912, occurs when the defence-terms predominate in the second members of the equations. We have then approximately

$$\frac{dx_1}{dt} = k_{12}.x_2, \qquad \frac{dx_2}{dt} = k_{21}.x_1,$$

and both x_1 and x_2 tend towards infinity.

I submit that the equations do describe, at least crudely, the way in which things have been done in the past. As to the future, while indicating the desirability of disarmament-and-satisfaction, they suggest that such a condition might easily become unstable, and that there is a need for controlling terms of a quite novel type. More strength to the statesmen who are trying to provide such !

Lewis F. Richardson.

38 Main Road,
Castlehead, Paisley.
April 11.

Some Uses of the Air-Driven Spinning Top

Since no measurements have so far been published, from any country, on colloidal systems using the air-driven spinning top of Henriot and Huguenard[1], it is evident that the great importance of this remarkable tool has escaped the attention of most laboratories. This is especially surprising in view of the fact that any good mechanic can make the necessary simple equipment (a stator and a hollow rotor) for a cost of about two or three pounds, and that for most purposes no special precautions need be taken as to constancy of temperature or control of pressure. With much less than the pressure of air available in an ordinary garage, the top may spin at several thousand revolutions per second, producing centrifugal forces of the order of 10^5–10^6 times gravity.

We therefore mention a few of the purposes which since 1931 we have found to be served by the use of this intriguing invention in one of the forms perfected by the originators[1]. This is quite apart from the elaborate studies which have proved necessary in the attempt to develop the top as a convectionless transparent ultra-centrifuge, paralleling those of Svedberg. These will be reported on elsewhere[2]. We only remark here that in one case last year an accidental disturbance created a sharp boundary in a sedimenting solution of mercuric chloride, affording a unique opportunity of observing a sedimentation constant S, as measured upon the photographs, equal to $8{\cdot}90 \times 10^{-13}$ as compared with theory $8{\cdot}91 \times 10^{-13}$.

Convection does not occur in an immobilised system. Sedimentation may be observed by eye, by callipers, by a scraping pipette, or by pouring off supernatant liquid and weighing. Evaporation is minimised by a solid cover or by a thin piece of cellophane which can be perforated by a hot wire without disturbing the spinning top. We find that the best method of preventing interaction between steel tops and their contents is to bake on several thin coats of bakelite lacquer. One may take advantage of these factors in the following ways :

(*a*) Measurement of rate of sedimentation of jellies and curds. Examples studied : agar, silicic acid, and sodium palmitate in water ; soap jellies in non-aqueous solvents.

(*b*) Purification of gelating colloids. Examples studied : agar, where half of the agar does not sediment with the rest of the agar jelly.

(*c*) Measurement of swelling pressure of jellies. When the jelly refuses to sediment further, it is in equilibrium with its swelling pressure.

(*d*) Replacement of ultra-filtration. Supernatant liquid or mother liquor may be removed from a sedimenting system, avoiding all effects of pore-size or adsorption.

(*e*) Measurement of bound or combined water in colloidal or biological systems using a reference substance separated as in (*d*) for analysis.

(*f*) Bound water, by increasing the density through addition of indifferent substances until sedimentation just ceases to occur. Then the reciprocal of the density of the system is identical with the partial specific volume of the non-sedimenting structure. The composition corresponding to this partial specific volume may be read from a table or graph of densities against composition. The simplest graph to read is that for the jelly itself, as for example agar in pure water.

(*g*) Determination of sorption. Example : methylene blue, which is strongly adsorbed by most materials, using method (*d*).

(*h*) There are many other possibilities, such as the observation of sedimentation equilibrium within any immobilised system.

We are of the opinion that all chemical, biological, metallographic and applied science laboratories might well employ one or more of these simple devices. Physical laboratories have long recognised the usefulness of solid tops as originally developed[1] for the measurement of the velocity of light, either with a path of only one metre or with the refinements and precision of the last work of Michelson.

James W. McBain.

Department of Chemistry,
Stanford University,
California.

[1] E. Henriot and E. Huguenard, *J. Phys. et le Radium*, **8**, 433 ; 1927. *C.R.*, **180**, 1389 ; 1925.

[2] A private communication from Prof. J. W. Beams describes another beautifully simple and elegant means of eliminating the most serious difficulties of ultra-centrifuge design ; this will appear shortly in *Science*.

A New Test of the Magneto-Ionic Theory

According to the magneto-ionic theory of Appleton[1], we should expect a wireless wave incident on the ionosphere to be returned to the earth as two differently polarised components (the ordinary and the extraordinary) with a slight difference in the time of travel. For wave-lengths shorter than 214 metres (the critical wave-length of the theory, given by the expression $\lambda = \frac{2\pi mc^2}{He}$), the theory has been experimentally confirmed[2,3] and the following points are well established :

(*a*) The two magneto-ionic components are circularly polarised.

(*b*) The left-handed (ordinary) component penetrates the F region and the E region more easily than the right-handed (extraordinary).

(*c*) The intensity of the extraordinary wave decreases markedly as the magneto-ionic critical wave-length is approached. The theory predicts different results for waves of length greater than 214 metres, but so far as we know, experiments have not been made to test it for these wave-lengths.

To test the theory for the longer wave-lengths the following conditions are necessary :

(*a*) The wave-length must be sufficiently removed from the magneto-ionic critical wave-length, so that the extraordinary wave is not too strongly absorbed. This necessitates the use of a wave-length greater than 400 m.

(*b*) To investigate the relative penetrating powers of the two magneto-ionic components, it is necessary to work at a time when the ionisation density in one of the ionospheric regions is small enough to permit at least one component to penetrate. This occurs only with the *E* region, and then only at midnight in midwinter.

During January and February of this year we have made experiments to compare the behaviour of waves of length greater than 214 m. with the well-known behaviour on shorter wave-lengths. Pulse transmissions of the Breit and Tuve type were provided from a nearby transmitter and the wave-length could be varied within the range from 400 metres to 500 metres. The receiver was equipped with a circularly polarised aerial so that the polarisation of the received echoes could be investigated. The values of the equivalent height, the state of polarisation, and the relative intensity of the two component waves were all determined for a series of different wave-lengths.

The results of the experiments were as follows :

(*a*) For wave-lengths greater than 214 metres the right-handed (extraordinary) component penetrates the *E* region more easily than the left-handed, so that it may be reflected from the *F* region while the left-handed component is reflected from the *E* region. This is the opposite of what happens on the shorter waves and is in accordance with the theory.

(*b*) The fact that the extraordinary component is reflected at all means that in the reflecting regions the quasi-transverse approximation to the magneto-ionic equations must hold, that is,

$$\frac{y_T^4}{4y_L^2} > z^2 + (1 - x)^2,$$

using the nomenclature of reference 1.

(*c*) For wave-lengths which just penetrate the *E* region, the *F* region echo is split, with the extraordinary component uppermost. This may be due to differences in the group velocities of the two components in the *E* region or in an intermediate region.

(*d*) On several occasions there was evidence of reflection from an intermediate region at an equivalent height of about 150 km.

F. T. Farmer.
Cavendish Laboratory, J. A. Ratcliffe.
Cambridge.
March 1.

[1] Appleton, *J. Inst. Elec. Eng.*, **71**, 624 ; 1932.
[2] Appleton, *Proc. Phys. Soc.*, **45**, 208 ; 1933.
[3] Ratcliffe and White, *Phil. Mag.*, **16**, 432 ; 1933.

Detonation of Nitrogen Iodide, $NI_3.NH_3$

When moist nitrogen iodide is suspended in air over phosphorus pentoxide in a glass vessel and the vessel evacuated by a mercury vapour pump, the crystals detonate as soon as they become dry. On the other hand, the substance can be completely decomposed into iodine and permanent gases without detonation occurring if the pressure of the permanent gases be not allowed to fall below 2×10^{-3} cm. At room temperature the decomposition can be completed in 12–24 hours. On carrying out the decomposition at −20° C. there is little reaction until the water is removed, after which the pressure rises linearly for a time. As iodine begins to condense out on the walls of the glass vessel, the rate of evolution of gas decreases and ultimately the pressure reaches a constant value, although some nitrogen iodide is still undecomposed. After this steady state is reached, on subjecting the residue to a hard vacuum it detonates. On detonation, the amount of permanent gas produced is only 30–50 per cent of that liberated during the thermal decomposition.

The thermal reaction is retarded by the easily condensible products of decomposition and also by water, and on removal of these substances, nitrogen iodide detonates spontaneously. This accounts for its extreme sensitivity to a blow, for this will create fresh surfaces which are unstable. The solid reaction gives rise to reaction chains which are infinite in length when the surface is free from adsorbed gases.

W. E. Garner.
W. E. Latchem.

University,
Bristol.

A Further Reappearance of the Second Red-Eye Mutation in *Gammarus*

Through the kindness of Mrs. Sexton, of the Marine Biological Laboratory, Plymouth, I was able to obtain a stock of a new mutation producing red, instead of the normal black, facets in the eyes of the amphipod *Gammarus chevreuxi*, Sexton. It had appeared in the first F_2 of a pair from a dredging taken in Chelson Meadows, near Plymouth, about a year ago, and my intention was to make a study of the effects of temperature on this mutant similar to that made by E. B. Ford and J. S. Huxley (1927) on the first red-eye mutation. For this purpose it was necessary to cross the new form with the red-eye mutations which had previously appeared, in order to determine whether or not it was homologous with any of them.

The following results have now been obtained : When crossed with the first red-eye stock (r_1), all the F_1 offspring had black eyes. With the second red-eye stock (r_2), the following F_1 families have appeared : (*a*) One black- and sixteen red-eyed young. (*b*) With different parents : a single red-eyed specimen, about six weeks after mating. (*c*) With different parents again : three red-eyed young about a fortnight after mating, and a further seven red-eyed ones about three weeks later.

Doubtless the explanation of the single black-eyed individual in the first family obtained with the second red-eye stock, is that some of the sperms from the previous mate of the female had remained behind and fertilised one or more of the eggs, causing the appearance of a heterozygous black-eyed specimen—not an unusual phenomenon in *Gammarus*. The long period elapsing between the separation of the female and the appearance of the young precludes such an occurrence in the second brood, while in the last instance, the female, after producing the first red-eyed family, had been mated with a homozygous black-eyed male before being again given a red-eyed mate, so that if any sperm had been left over from a previous mating some of the second family would have had black eyes ('black' is dominant to 'red'). The present gene therefore proves to be a reappearance of the second red-eye factor.

From the results already obtained by Sexton and Clark[1] we may infer that this recessive gene is somewhat widely spread in the wild population, and any further information on this subject appears to be of value.

K. W. YARNOLD.

Department of Zoology and
Comparative Anatomy,
University of Oxford.
March 16.

Sexton, E. W. and Clark, A. R., NATURE, **131**, 201; 1933.

Composition of Interveinal Mosaic of Potatoes

IN a recent paper from Madison, Wis., Koch and Johnson[1] state that they have found in interveinal mosaic of potato received from this laboratory a "streak" (Table VII) which is presumably identical with the new virus described in the text (p. 45) as "potato streak virus". We had already found in 1933 and 1934 that this interveinal mosaic results from the combined action of viruses of two different types, one of which may correspond to the streak of Koch and Johnson, since there is no present evidence of a further constituent. In the circumstances, it is desirable to publish this note although the work is not complete.

One of the constituents of interveinal mosaic is a virus of the *X*-type which has no known insect vector. The other constituent is selectively transmitted under certain conditions by the aphis *Myzus persicæ*, Sulz., contrary to the conclusion of Koch and Johnson regarding their virus, and it has been isolated both in this way and by passage of interveinal mosaic through the potato variety Arran Crest, in which the *X*-virus does not survive.

The virus thus separated by the two methods sometimes produces on the foliage of President potato a slight transient mottle, but one of its diagnostic features is the production of irregularly arranged necrotic blotches in the cortex and pith of the tubers of this variety, and it is regarded as responsible for this symptom in interveinal mosaic. Koch and Johnson make no reference to this, and they were consequently not in a position to know that the virus is related to, if not identical with, that causing phloem parenchyma necrosis (or pseudo-net necrosis) as defined by Quanjer, Thung and Elze[2,3]. Its full identity, however, has not yet been satisfactorily established, and it is provisionally entitled the 'tuber blotch virus'.

Another diagnostic character of the virus is its power of combining with simple mosaic (virus *X*), thereby intensifying it to interveinal mosaic, and the latter has been synthesised in this way. This reaction can only follow in a variety which is tolerant of both viruses, for if it is intolerant of either, 'streak' results. Thus the simple mosaic element alone would cause this symptom in Arran Crest, while the tuber blotch virus was presumably responsible for the 'streak' which Koch and Johnson produced in the experimental Bliss Triumph, since the plants already carried the equivalent of simple mosaic.

The tuber blotch virus is readily inoculable into tobacco (var. White Burley) and *Datura Stramonium*, but it is carried by the latter and also probably by the former. It does not survive nine days *in vitro* at room temperature, and does not pass the L3 or L5 Pasteur-Chamberland filters, while the *X* virus does so, and has been readily separated in this way.

Whatever the identity of the tuber blotch virus turns out to be, it is unfortunate in the present circumstances that Koch and Johnson should have given the virus they worked with the new name of "potato streak virus". This term is likely to lead to further confusion, since it had been used previously in a looser sense, and at the present time the name 'streak' as applied to potato viruses is devoid of meaning, seeing that the majority, if not all, of them produce streaking on intolerant varieties.

J. B. LOUGHNANE.
PHYLLIS CLINCH.

Department of Plant Pathology,
Albert Agricultural College,
Glasnevin,
Dublin.

[1] *Ann. App. Biol.*, **22**, 37–54; 1935.
[2] *Meded. Landbouw., Wageningen*, **33**; 1929.
[3] *Phytopath.*, **21**, 577–613; 1929.

Physiological Polarity in *Aspergillus*

WORKING with a certain strain of *Aspergillus nidulans* (Eidam), Winter, I have proved and described a particular type of 'physiological polarity'[1]. It is important to verify this polarity with other strains of the same species.

I should be obliged therefore if mycologists would send me specimens of *Aspergillus nidulans* with perithecia, and indication of the origin. I require the fungus from its natural sources, and not from strains found in the laboratory, as it is necessary that I should carry out the isolation myself. I should be grateful to have the material sent c/o Centraalbureau voor Schimmelcultures, Baarn, Holland, where I am working at present.

P. HENRARD.

Collège philosophique,
Eegenhoven, Louvain.
March 13.

[1] "Polarité Hérédité et Variation chez diverses espèces d' *Aspergillus*," *La Cellule*, **43**, 350–424; 1934.

Preparation of Diazomethane and its Homologues in the Free State

WE have recently prepared for the first time an extended series of the homologues of diazomethane, but only in ethereal solution[1].

For the systematic study which we contemplate of the physical and also of the chemical properties of this series, however, it is requisite that the several compounds should be available in the free condition. We have now achieved this in a number of instances by decomposing the nitroso-β-alkylamino*iso*butyl methyl ketones in a reflux apparatus at 70° under somewhat reduced pressure in presence of a small quantity of anisole, by means of sodium benzylate, and obtained yields which in certain cases even surpass those already recorded; for example, of diazomethane 81 per cent, of diazoethane 64 per cent, of diazopropane 59 per cent, of diazobutane 46 per cent.

D. W. ADAMSON.
J. KENNER.

Department of Applied Chemistry,
College of Technology,
Manchester.
April 12.

[1] *J. Chem. Soc.*, 286; 1935.

Points from Foregoing Letters

Sir Joseph Larmor makes critical comments on theories of magneto-optic rotation and suggests that valuable information might be obtained by the application of modern technique to the measurement of the intensity across the Zeeman spectral components (spectrum lines resolved and polarised by the action of a magnetic field).

Artificially produced radioelements can be partially separated by carrying out the transmutation in the presence of an electric field, according to Prof. F. A. Paneth and Mr. J. W. J. Fay. Using a gaseous arsenic compound, which by bombardment with neutrons gave radioactive arsenic, they were able, by the application of an alternating electric field, to concentrate 20,000-fold the radioactive material produced.

Accepting the view that primary cosmic rays consist of two groups of particles, namely, positive and negative electrons and positively charged hydrogen nuclei, Dr. Pierre Auger indicates that, as they penetrate through matter, their interaction with elements of low and high atomic weight leads to the production of secondary phenomena, such as the penetrating radiation and electron showers observed.

The power of proteins and similar substances (choline, betaine) of decreasing the fat content of liver is discussed by Prof. C. H. Best and Messrs. M. E. Huntsman and J. H. Ridout. They give results of experiments on rats which lead them to believe that Channon and Wilkinson have emphasised unduly the effect of moderate under-nutrition on the deposition of liver fat; they find that slight change in body weight does not affect the liver fat balance.

Mr. Alec H. Laurie, who has just returned from a whaling expedition, describes personal observations indicating that whales do not fill their lungs with water when diving (to prevent caisson sickness due to liberation of dissolved nitrogen). Mr. Laurie's previous experiments with whale blood have shown that it has the property of using up dissolved nitrogen.

The freezing point of a solution is no guide to the osmotic pressure it will exert across an animal membrane. Mr. J. Z. Young therefore advises that solutions used for hardening or 'fixing' tissues of sea animals should contain the saline constituents of sea-water in the same concentration, in order to prevent distortion or bursting of the cells due to penetration of water.

Dr. W. N. Bond offers further evidence in support of his suggestion that the cause of the discrepancy between experiment and Eddington's theoretical value, M/m, for the electron, is that experiment measures not e/m but 136/137 e/m. It is suggested further that since X-ray determinations and Millikan's method give different values for the electronic charge, approximately in the value 137/136, the reason for this lack of agreement is the same as in the first case, namely, faulty analysis of a 'system' into 'parts'.

Mr. K. Mendelssohn and Miss Judith R. Moore describe the magnetic properties of a lead-bismuth alloy at temperatures near the absolute zero, when it becomes supra-conducting. A possible explanation for the phenomena observed is that the 'threshold value' (temperature at which supra-conductivity begins) is high in some parts of the alloy while the main part has about the same value as pure metals. Such a model would act like a fine supra-conducting sponge, the meshes of which are formed by annular regions of high threshold value impenetrable for magnetic flux that has once been caught in them.

The electrical resistance of very pure aluminium just before it becomes supra-conducting has been investigated by Mr. H. A. Boorse and Dr. H. Niewodniczański; between 4·2° and 2·2° K., the resistance is constant.

Dr. F. P. Bowden and Mr. S. H. Bastow have measured the resistance to flow of thin films of water and of soap (ammonium oleate) solution, and have failed to confirm the rigidity deduced by Derjaguin from observations on the resistance offered by water to the movement of an oscillating lens. This, they believe, disproves the view that oriented chains of water molecules may extend to a distance of 5 μ from the surface.

Using radioactive isotopes as indicators, Mrs. Alice Leigh-Smith and Dr. H. O. W. Richardson find that in compounds of metals with organic radicles, exchange of atoms of the same atomic number occurs without the break-up of the molecules.

A method of determining minor quantities of water, such as are produced during the partial decomposition of some organic compounds, is described by Prof. W. Swietosławski. It depends upon the lowering of the boiling point of azeotropic mixtures of certain organic liquids (mixtures which distil in a constant ratio) produced by small amounts of moisture. The method has been applied by Mr. M. Wojciechowski to the determination of small amounts of substances adsorbed at solid surfaces.

By means of a new optical method, Prof. H. Falkenhagen and Mr. Ch. Bachem have measured the compressibility of solutions. They find a linear relation between the apparent molal compressibility and the square root of the concentration of the electrolyte, in accordance with Gucker's theory, but the relation does not hold for non-electrolytes, such as sugar.

Dr. L. F. Richardson directs attention to a mathematical formula in which he has attempted to express the armament race between opposing nations or groups of nations in terms of a "defence coefficient", a "fatigue and expense coefficient" and a quantity depending upon dissatisfaction with treaties.

Messrs. F. T. Farmer and J. A. Ratcliffe have investigated the application of Appleton's theory of the ionosphere to radiation of wave-length greater than the critical value of 214 m. Observation of the ordinary and extraordinary reflected rays which have partially penetrated the E and F reflecting layers confirms the theory, and suggests that reflection occasionally occurs from an intermediate region at 150 km.

Mr. J. B. Loughnane and Miss Phyllis Clinch state that interveinal mosaic disease of potatoes is due to the combined action of two viruses, one of which is transmitted by the green fly *Myzus persicæ*, whilst the other has no insect carrier.

Mr. D. W. Adamson and Prof. J. Kenner report the preparation, for the first time, of a number of compounds belonging to the diazomethane ($C_2H_2N_2$) series. These are highly reactive, poisonous and explosive substances.

News and Views

Award of the Mueller Medal to Dr. R. J. Tillyard, F.R.S.

THE Mueller Medal of the Australian and New Zealand Association for the Advancement of Science was presented to Dr. R. J. Tillyard, Chief Commonwealth Entomologist, at the recent annual meeting of the Royal Society of Australia held at Canberra. This medal, which was established in 1896 by a group of scientific workers in Victoria, commemorates the services to Australia of Baron Ferdinand von Mueller, and is the premier award in the gift of Australian men of science. According to the *Canberra Times*, Dr. A. B. Walkom, general secretary of the Australian and New Zealand Association, made the presentation. In his address, he recalled the names of previous recipients of the Mueller Medal, among whom have been J. H. Maiden, Leonard Cockayne, W. Howchin, Sir Douglas Mawson, Sir Edgeworth David and Prof. Wood Jones. Dr. Tillyard, he said, has many notable investigations to his credit; in particular, he has studied the biology of the dragonflies, the wing venation of insects and the determination and classification of fossil insects. He has also published a valuable and comprehensive textbook on the insects of Australia and New Zealand. Dr. Tillyard's work in entomology, in both New Zealand and Australia, has been of outstanding value, establishing principles and facts of wide interest and great importance.

Presentation to Sir Denison Ross

AT the recent annual anniversary general meeting of the Royal Asiatic Society, Sir Denison Ross, director of the School of Oriental Studies, London, was presented with the Triennial Gold Medal for his work in forwarding Oriental research during the period concerned. The presentation was made by H.E. The Iranian Minister, a very happy arrangement as a great deal of Sir Denison Ross's time has been devoted to the study of the Persian language and Iranian dialects. He was the guest of the Iranian Government on the occasion of the festivities held in Iran, in honour of the millenary of Firdausi, the national poet of Persia. The gold medal trust was founded in 1897 to commemorate the Diamond Jubilee of Queen Victoria. The selection of the recipient is made by a special committee appointed by the president and council of the Royal Asiatic Society for the purpose, from among their number. The previous recipients have included Prof. E. B. Cowell, E. W. West, Sir William Pope, V. A. Smith, A. H. Sayce, D. S. Margoliouth and Sir Aurel Stein. In mentioning some of Sir Denison's services, the Iranian Minister dwelt on his love of Persian studies and his constant travel in the East. He thought that Sir Denison must own a special kind of magic carpet from the "Arabian Nights", for he attended the Firdausi celebrations in Teheran and elsewhere, but was able to reach London in time for Firdausi week here. His studies had kept alight the torch of Oriental learning in England and India.

U.S. National Academy: Elections and Awards

IT is announced by Science Service, Washington, D.C., that the following have been elected members of the U.S. National Academy of Sciences: Dr. N. L. Bowen, Carnegie Institution of Washington, geologist; Dr. C. M. Child, the University of Chicago, zoologist; Dr. G. E. Coghill, Wistar Institute, Philadelphia, chemist; Dr. James Ewing, Memorial Hospital, New York City, pathologist; Dr. M. L. Fernald, Gray Herbarium, Cambridge, Mass., botanist; Dr. Harvey Fletcher, Bell Telephone Laboratories, New York City, physicist; Dr. Ross Aiken Gortner, University of Minnesota, chemist; Dr. E. A. Hooton, Harvard University, anthropologist; Dr. J. C. Hunsaker, Massachusetts Institute of Technology, aerodynamist; Dr. Walter S. Hunter, Clark University, psychologist; Dr. Dunham Jackson, University of Minnesota, mathematician; Dr. Chester R. Longwell, Yale University, geologist; Dr. H. C. Urey, Columbia University, chemist; Dr. J. H. Van Vleck, Harvard University, physicist. New foreign associates of the Academy are: Dr. J. S. Haldane, director of the Mining Research Laboratory and honorary professor in the University of Birmingham, and Dr. Jules Bordet, director of the Pasteur Institute, Brussels. Dr. Frank R. Lillie has been elected president of the National Academy of Sciences for a term of four years. He is dean of the division of biological sciences at the University of Chicago and president of the Woods Hole, Mass., Marine Biological Laboratory.

THE following awards have been made by the National Academy of Sciences: *Public Welfare Medal* to Prof. August Vollmer, of the University of California, for his work in police administration; *Daniel Giraud Elliot Medal* to Dr. James P. Chaplin, of the American Museum of Natural History, for his work on the birds of the Belgian Congo; *Henry Draper Medal* for astronomy to Dr. J. S. Plaskett, director of the Astrophysical Laboratory at Victoria, British Columbia; and *Agassiz Medal* for oceanography to Prof. Haakon Rasberg Gran, of Oslo.

"Backward Tracts" in the India Bill

FURTHER consideration was given to the position of the aboriginal tribes under the provisions of the India Bill in Committee of the House of Commons on May 9 and 13, when an amendment to Clause 6 was moved by Mr. Cadogan (Finchley, U.) proposing the extension and modification of the excluded and partially excluded areas named in the schedule thereto. The "anthropologists", as Mr. Winston Churchill happily termed the supporters of the amendment, urged with vigour the necessity for a much wider application of the principle of exclusion, by which jungle and hill peoples living under tribal conditions remain outside the jurisdiction and administration of the Provincial Governments and are

entrusted to the care of the Federal Governor. It is evident that while the Government is in sympathy with the principle, difficulty has been felt as to the limits to which its application is a practical possibility. The Under Secretary to the India Office (Mr. Butler) explained what these difficulties are. While mainly administrative, especially where 'pockets' of aboriginal tribes live among a more advanced population, they also entail the possibility of a retrocession where some cultural advance has already been made.

LORD EUSTACE PERCY pointed out that it had not been possible to provide the House with the detailed information requisite for a decision on the detailed amendment of the schedule; and it is probable that the wisest course was followed in the adoption of the suggestion of the Attorney General (Sir T. Inskip) to withdraw the question from immediate discussion by the omission of the schedule from the Bill and the preparation of an Order in Council for submission to the House after all necessary information had been obtained. Members thus have the assurance that they will at least be in full possession of the facts, and the "anthropologists" will be in a position to gauge how far it will be possible to avert the danger of oppression, which is feared, through clash of culture, under the Provincial Governments. In the meantime, the important pronouncement has been made that the policy of the Government in dealing with the question of the aboriginal tribes is assimilation rather than segregation.

Aborigines and the Law in Australia

IT is evident that public opinion in Australia has been stirred by recent decisions of the courts in criminal cases in which aborigines have been implicated. Two aborigines undergoing sentence for killing a goat have been released from Port Augusta gaol, according to an Adelaide cable in *The Times* of May 7, by the Governor of South Australia, Major-General Sir William Dugan, in response to a petition from the Aborigines Friends Association. It was stated that the crime was committed under stress of great hunger and in ignorance of the white man's laws. This decision has renewed interest in the case of the two aborigines recently condemned to ten years imprisonment for killing a fellow-tribesman who had revealed ritual secrets. No doubt an effort will be made to secure some modification of the decision in this case also. These, unfortunately, are not the only cases affecting aborigines which have attained notoriety and caused misgiving as to the judicial procedure in dealing with crimes and misdemeanours of aborigines. They point to the need of a special tribunal and a penal code *ad hoc*, which will take fully into account aboriginal culture and outlook on life, property and society. It is surely anomalous that while the Federal Government, for example, fosters continued tribal existence by securing to the aborigines the rights of access to traditional hunting grounds and water-holes, it forces them to abrogate tribal custom by submission to a code and tribunal appropriate to the civilisation and outlook of the white man.

Excavations at Tell el-Amarna

IN the season's excavations of the Egypt Exploration Society at Tell el-Amarna, which have recently been brought to a close, the most notable achievement has been the completion of the exploration of the great palace of Akhenaten, or rather of what was left of it by the spoilers by whom it was destroyed at the collapse of the Aton religion and the abandonment of the city. The building was of a remarkable size. It has now been shown by the recent excavation to have been little less than a kilometre in length. At the south end was a vast hall in which the roof was supported by six hundred square pillars of mud brick. The walls had been covered with faience tiles in green with a characteristic decoration of inlaid white daisies. Among the relics found in this building were a large number of fragments of huge statues. These evidently had occupied a position along a plaster pavement leading to a columned hall. They had apparently stood on the oblong bases which were found at intervals along this passage. It is to be concluded that the statues were hacked to pieces when the palace was destroyed. Near the palace entrance was a well-preserved copper crowbar, which, no doubt, had been used as one of the implements of destruction. Among the examples of the sculpture, for which the site is now famous, this season's finds included a remarkably fine head of Akhenaten executed in black granite.

Bronze Age Burials near Bournemouth

A REMARKABLE example of a bronze age barrow is now in course of excavation at Dudsbury, near Bournemouth. Its method of construction is believed to be unique in the British Isles. Beneath the sand and gravel forming the surface of the heath on which it is situated, it is stated by a correspondent of *The Times* in the issue of April 26, that Col. C. D. Drew, who is conducting the excavation, has found a mound of turves, three feet thick at the centre. No skeletal remains were found in this mound, which constitutes the primary interment. For this, the acidity of the soil is held responsible, all animal remains being destroyed by its action. A secondary interment took place in the top of this mound, and above it was piled a further six feet of turves with a top dressing of other soil. In the secondary interment was an inverted cinerary urn which had covered the ashes of the incinerated body. It is of Middle Bronze Age type (c. 2,000–1,500 B.C.) and has an ornamentation of three horizontal grooves running around it and finger-nail marks on the rim. It is about 16 inches high and 12 inches in diameter. It will be deposited eventually in the Dorchester Museum.

Progress in Aero-Engine Design

THE Bristol Aeroplane Company has just completed the official tests of an improved engine, to replace the standard Pegasus III air-cooled radial

engine now in production. This engine, known as the Pegasus X, gives an output of 920 horse-power at ground-level, and maintains 875 horse-power at 6,000 ft. altitude, with a remarkable weight of only 995 lb., completely equipped. This figure of 1·08 lb. per H.P. is the least weight/power ratio ever reached in a production type of aero engine, designed to stand up to the conditions of everyday use. The Rolls-Royce racing engine produced for the last Schneider Trophy race had a ratio of only 0·7 lb. per H.P., but this was not a production type. The fuel consumption of the Pegasus X is also as good as any other type in existence; earlier air-cooled engines compared badly with contemporary liquid-cooled types in this respect. It also standardises a controllable pitch airscrew, carrying the fittings for the hydraulic control gear integral with itself. It is interesting to note the progress in weight reduction in aero engine practice since the adaptation of the internal combustion engine to flying requirements. In 1903 the Wright Bros. original engine weighed 12·7 lb. per H.P. In 1913 the average was about 4·9 lb., while during the War period, 1914–18, rotary engines were produced as low as 2·5 lb. The lowest weight to-day, previous to the new Bristol engine, was 1·15 lb. per H.P.

Increase of Power Output in Aeroplanes

SCIENCE SERVICE, of Washington, D.C., reports that, in future, U.S. Army aeroplanes will be delivering approximately 70 per cent more power per pound of gasoline than was the case seven years ago. In 1928 an increase of 33 per cent in power output was obtained by alteration of engine design to utilise 92 instead of 50 octane gasoline; and now a further increase is envisaged by the substitution of special lead blended iso-octane for the 92 octane gasoline. Petroleum will still be used as a raw material in the production of this fuel, but the molecules will be 'torn down' and 'rebuilt' into new fuels. The composition of such fuels will be half *iso*-octane, which is now being manufactured in substantial quantities by several refineries, and half good quality ordinary aviation spirit with the addition of 'ethyl'. The cost per gallon of the final product will be higher than that of present aviation fuels, but since its power per pound is greater it ought in the long run to prove more economical. The practical result of its utilisation will be to enable aeroplanes to fly farther and faster without increasing the weight of fuel carried.

Parliamentary Science Committee

A MEETING of the general committee of the Parliamentary Science Committee was held at the House of Commons on May 14, Sir Arnold Wilson in the chair. It was reported that recent accessions to the list of bodies allied to the Committee include the Institution of Civil Engineers, the Institute of Chemistry and the National Veterinary Medical Association. In the period reviewed in the Honorary Secretary's report, special mention was made of the Committee's successful efforts to secure consideration of the claims of scientific research in connexion with the Metropolitan Water Board Bill now before Parliament. Other activities reported included certain aspects of the Government of India Bill, the exemption from income tax of funds expended on industrial research, and the claims of science and technology to representation in the higher administrative posts in Government service. Sir Arnold Wilson addressed the Committee and in his concluding remarks said: "It will take time to evolve a suitable mechanism and a live organisation, but, if sufficient support is forthcoming and the membership widened to cover science as a whole, there is no reason why we should not be of real use and value to the nation; for it is in Parliament, and nowhere else, that the balance between science and ethics has to be settled, day by day, in terms of statutes and regulations".

British Postgraduate Medical School

H.M. THE KING formerly opened the British Postgraduate Medical School at the L.C.C. Hospital, Ducane Road, Hammersmith, on May 13. It will be recalled that the School arose out of a recommendation of a committee under the Earl of Athlone that London should have a centre for medical postgraduate work comparable with the great continental medical schools, which should be attached to the University and receive substantial Government support. By the co-operation of the Government, the University of London and the London County Council, one of the hospitals under the last-mentioned body was allocated and specially enlarged and equipped for the purpose (see NATURE, April 21, 1934, p. 600). Their Majesties were received by Sir Austen Chamberlain, chairman of the governing body of the School, who described its inception, stating that the School has three great tasks: to enable general practitioners to become familiar with the latest developments in diagnosis and treatment; to provide instruction for graduates undertaking specialist studies; and to promote research and advance medical knowledge. The King, in his reply, said that "The provision within the University of London of a new centre for clinical teaching marks a notable advance in the continuous effort of the medical profession to increase its capacity for service to mankind". He concluded by expressing the hope that "this school, with its happy union of ward and laboratory, university and local authority, drawing students and teachers alike from all parts of our Empire, and . . . from regions even more widely spread . . . [may] play an imperial rôle in the winning and dissemination of medical knowledge, in the relief of suffering . . . and in enabling the doctors of all lands to come together in a task where all must be allies and helpers."

Mechanisation of Industry

IN an article in the Royal Jubilee number of *Engineering* published on May 3, Sir Richard Redmayne says that the mechanisation of industry tends to increase both the wages and the time available for leisure of the operatives, and thus increases their material welfare without the application of what are

known as 'revolutionary methods'. He illustrates this progress by what is happening in the coal-mining industry. The hewing of coal by pick and filling it into a tub by shovel, in a more or less confined space, is work of the most arduous nature. The great expansion during recent years of mechanical coal cutters has made this work comparatively easy. In 1900 only 1·5 per cent of the British coal output and 25 per cent of the output of the United States was cut mechanically. In 1932 this had risen to 38 per cent in Britain and 68 per cent in the United States. In the Ruhr coalfield the mechanical pick has found great favour; in 1913 only 2·2 per cent was cut mechanically, now 90 per cent is, 84 per cent being cut by mechanical picks and 6 per cent by mechanical coal cutters. The transport of the cut coal from the coal face to the shaft bottom was almost as laborious as 'getting' the coal. Now, owing to the perfection of electrically actuated plant, not only is the haulage on the main roads carried out electrically, but in the secondary roads also it is replacing horses and ponies. So far as creation of wealth and increase of leisure and comfort of the mass of mankind are concerned, the engineer has taken a leading part. During the last 130 years, wages in coal-mining have risen 3·2 times and the daily time of labour has been decreased 37 per cent, the return on the capital remaining on the average stationary. The chief beneficiary under the system of mechanisation has been the manual worker. There is no doubt that the rationalisation of industry tends to decrease the number of employees, but Sir Richard Redmayne thinks that the lowering of the price of the commodity, its more effective distribution leading to the increase of new industries, together with the increase in wages and leisure creating an increased demand, will result in more than the absorption of the overplus of labour.

Unemployment among Young Persons

THE International Labour Office estimates that of about 25 million unemployed throughout the world, about one fourth, or 6–7 million, are young persons less than twenty-five years of age. In Great Britain the percentage between fourteen and twenty-four years old was 30·2 per cent in 1931, a figure which indicates the significance of the National Jubilee Trust inaugurated by the Prince of Wales. The corresponding figure for Switzerland in July 1934 was 15 per cent, but for Hungary in 1930 it reached 42 per cent; in Italy in 1932, 41·5 per cent of the unemployed were between fifteen and twenty-five years of age. These figures indicate the quantitative significance of the discussions on unemployment among young persons at the International Labour Conference opening at Geneva on June 4. They do not, however, reveal the demoralising effects of prolonged unemployment, which are much more serious among young than among older persons. Steps already taken by various countries to deal with this position are indicated in a report prepared by the International Labour Office as a basis for the discussions. The report suggests that most of the measures to be taken to ameliorate unemployment among young persons call for pooling of experience rather than for the drafting of a convention. Particular stress is laid upon the raising of the school-leaving age to fifteen years; the creation of an increased number of technical schools; the organisation of vocational training centres in connexion with public employment agencies and the establishment of centres for recreation, physical training, etc.

Molecular Structure of Dielectrics

SIR WILLIAM BRAGG chose the molecular structure of dielectrics as the subject of the twenty-sixth Kelvin Lecture delivered on May 2 to the Institution of Electrical Engineers. He pointed out that the properties of dielectrics depend on their composition and on the arrangement of their atoms and molecules. During the past twenty-five years, men of science have used X-rays to study the structure of various substances, and engineers by other means have discovered many of the factors which govern the properties of dielectrics. It is now necessary that the two classes of workers should come together and pool their resources in making further advances. It is sometimes thought that X-rays are only of use for examining the structure of crystals, but it has to be remembered that crystallisation is a property of all substances. The crystal is used to obtain electron maps of the image of a single molecule and these maps enable us to find out the electron densities in its various parts. It is possible in many molecules to measure the exact distance from atom to atom, and to determine the way in which they are linked together to form the molecules. This method of attack can be used even when the molecules are not so definite in shape as they are in a crystal. Sir William pointed out the analogies between the properties of proteins and those of dielectrics and laid stress on the recent work done at Leeds by Mr. W. T. Astbury. Once the basic theory of dielectrics is determined, rapid progress will be made in practical applications. It is fortunate that the researches in the pure science of atoms and molecules and the many technical investigations now being carried on are feeling their way towards each other.

The New Commonwealth Society

ACCORDING to the annual report of the *New Commonwealth* for 1933–34, a clearer demarcation will in future be drawn between the research and propaganda activities of this organisation. Educational and propaganda work will be undertaken by the New Commonwealth Society, which will continue to be subdivided into an international section and the various national sections. Brief reports of the activities of all these sections are included, which indicate the extent to which the scientific study of international affairs is being encouraged in this way. The scientific investigations hitherto carried out by the Research Bureau of the International Section will now be carried out by the New Commonwealth Institute. These activities are guided by an Advisory Research Committee, which includes among its

members Major-Gen. Sir F. Maurice, Brig.-Gen. E. L. Spears, Prof. A. Zimmern, Prof. N. J. Baker, Prof. H. V. Temperley, President N. B. Butler, M. Nicolas Politis. This Committee will advise upon research work on the principles of international relations, questions of international justice, law and equity, and problems of international security. The publications of the Institute will include monographs and a quarterly review in English, German and French, and preparations are being made for the publication of a yearbook. The work is largely carried out by means of circular letters, but it is also proposed to hold conferences twice a year in different centres. A series of fortnightly 'round table' discussions has also been initiated.

Training for Industrial Management

IN a report entitled "Three Years' Experience and Results in the Training of Scientific Men for Industrial Management" (57 Gordon Square, London, W.C.1), Mr. W. R. Dunlop describes the work which he has carried out in providing facilities for training in this subject on the lines of personal and individual tuition, and more recently by correspondence. The courses, he explains, were not undertaken in the expectation of obtaining spectacular results; but experience has shown that scientific and technical men are definitely interested, and that those who have taken full advantage of the training have derived substantial benefit in one way or another. A difficulty has been to get something out of the students as well as putting something in. It has been hard to make chemists in particular understand that management is not a subject but an activity, and that action, energy and initiative as well as passive absorption of knowledge must be demonstrated in a course of training. Chemists in some cases appear to suffer from an 'inferiority complex' in regard to expressing opinions on matters outside their immediate province, while on the other hand many engineers, especially mechanical engineers, tend to go to the other extreme.

Public Health in British Colonies in 1932

THE fourth Supplement to the *Tropical Diseases Bulletin*, December, 1934, contains summaries by Dr. Harold Scott of medical and sanitary reports relating to the year 1932 from British colonies, protectorates, and dependencies. The summaries give for each country the year's record of vital statistics, maternity and child welfare work, school hygiene, general sanitation, housing and town planning, etc., followed by particulars of the tropical diseases occurring in them, and the measures taken locally to combat them. The records show, on the whole, that in spite of retrenchments of medical staffs and curtailment of expenditure on public health services, the general health of the English communities has been well maintained, and no appreciable increase of sickness has occurred in the native communities. Retrenchment has had the effect of bringing to the fore the question of the local training of natives for medical duties. In the Gold Coast, a scheme for the training of nurse-dispensers has been instituted, and elsewhere medical schools exist where native practitioners have been successfully trained.

Ross Institute Industrial Advisory Committee

A MEETING of this Committee, at which the chairman, Mr. G. H. Masefield, presided, was held on January 29 last at the rooms of the Indian Tea Association. The meeting was addressed by Sir Malcolm Watson, who described some of the anti-malarial measures that have been undertaken in Southern Rhodesia, Beira and some of the Gold Coast mines, by Mr. A. Wigglesworth, who raised the question of malarial conditions on sisal estates, and by others. Dr. Ramsay, of the Ross Institute in India, mentioned the 'eye fly', which is not only a nuisance but also a danger, as it transmits catarrhal conjunctivitis, and against which no effective measures are known except protection by means of wire gauze spectacles. Sir Malcolm Watson directed attention to a booklet on the prevention of malaria which is distributed free to those residing in, or proceeding to, the tropics. The Ross Institute, which is amalgamated with the London School of Hygiene and Tropical Medicine, is the medium through which industries in the tropics keep in touch with the work of the combined bodies and seek advice, and some £15,000 are required annually from voluntary subscriptions for propaganda work and appeals.

Microscopes and Accessory Apparatus

IN the 1934 edition of the catalogue issued by Messrs. Carl Zeiss (London), Ltd. (37 Mortimer Street, London, W.1), after an excellent introduction upon the theory of the microscope, the series of microscope stands manufactured is described. The design of the microscope stand has substantially altered in recent years, and the usual form now adopted consists of a broad base which supports a one-piece limb for carrying the illuminating system, the stage and the tube. This one-piece limb is in the form of a segment of a circle with a deep central recess. This recess serves as a handle, and provides ample range for a large stage. Another convenient modern device is the inclined tube, single or binocular, which can be fitted to most of the models, in some of which the fine-adjustment head is located in the tilting axis. A large range of Huygenian and compensating eye-pieces, and achromatic, fluorite and apochromatic objectives, are manufactured. Petrological and other types of special stands, magnifiers, hæmacytometers, micrometers, micro-manipulator, photomicrographic cameras and other accessory apparatus are also listed.

Research on Bird Migration

THE German Government has issued an announcement referring to the work of the German bird migration research stations—in Heligoland and at Rossitten—where rings are attached every year to the feet of more than 160,000 migratory birds. The rings are inscribed with identification numbers and with the address of one or other of the stations—"Vogelwarte Helgoland" or "Vogelwarte Rossitten"

respectively. The stations are anxious to receive reports of the finding of these birds in any part of the world with the view of gaining further information as to bird migration and other phenomena of bird life. They will gratefully acknowledge all such reports, and are prepared to furnish in reply information not only as regards the bird in question, but also as regards their work generally. Reports will be sufficiently addressed if directed to Vogelwarte Helgoland, Germany, or Vogelwarte Rossitten, Germany.

Federation of Scientific Societies in Australia

THE Australian National Research Council, having come to the conclusion, at a general meeting last January, that it is not properly fulfilling its function as a national body representative of scientific thought and endeavour, will, during this year, examine the possibilities of effecting a federation of the various State Royal Societies, the Linnean Society of New South Wales, and a number of professional organisations such as the Australian Chemical Institute, the Institute of Physics, the Institution of Engineers and the Australian Veterinary Association. The federation will be confined to bodies concerned with the physical and biological sciences. No constitution has yet been suggested, but the general proposal is that each constituent member shall retain its independence as at present and shall have the right to representation on the Federal Council. The nature of the representation and the definition of duties of the council will be the subject of discussion at a conference of delegates from the interested societies, to be called later by the present National Research Council.

Announcements

THE council of the Royal Society of Edinburgh has awarded the Makdougall-Brisbane Prize for the period 1932–34 to Dr. A. E. Cameron, lecturer in entomology, University of Edinburgh, for his publications in entomology, including his recent paper in the *Transactions*, "The Life-History and Structure of *Hæmatopota pluvialis* Linné (Tabanidæ)".

THE Prime Minister will open a Noise-Abatement Exhibition at the Science Museum, South Kensington, on May 31 at 11 a.m.

THE annual meeting of the Swiss Röntgen Society will be held at Montreux on June 15 and 16. Further information can be obtained from Dr. A. Grosjean, La Chaux de Fonds, Switzerland.

THE sixteenth annual congress of the German Association for Microbiology will be held in Berlin on May 26–28, when the subjects for discussion will be diphtheria and piroplasmiasis.

FOLLOWING the announcement that the Australian Government will erect a laboratory in Melbourne for the Forest Products Division of the Council for Scientific and Industrial Research, Mr. W. Russell Grimwade has offered to provide £5,000 for the purchase of additional apparatus and equipment for the new building.

THE following appointments have recently been made by the Secretary of State for the Colonies: Mr. A. M. Gwynn, entomologist, Agricultural Department, Nigeria, to be assistant entomologist, Agricultural Department, Uganda; Mr. H. R. Binns, to be veterinary officer, Nyasaland; Mr. R. G. Sangster, to be assistant conservator of forests, Uganda; Mr. J. Gordon, to be inspector of plants and produce, Gold Coast.

THE nineteenth National Baby Week will be held on July 1–7. The subjects for propaganda during 1935 will be the welfare of the pre-school child and the good nutrition of mothers and children. On July 1–3 a conference on "Maternity and Child Welfare", organised by the National Association for the Prevention of Infant Mortality, will be held in London. Further information can be obtained from the Secretary, National Baby Week Council, 117 Piccadilly, London, W.1.

THE Institution of Electrical Engineers is making arrangements for a summer meeting to be held in Belgium, probably on September 8–14. The programme will include excursions and visits to works, and among the towns included in the itinerary will be Brussels (which will probably be the headquarters town and where the Exhibition will still be in progress), Antwerp, Charleroi, Dinant, Langebrugge, Liège, Tirlemont, and also Ypres and other places in the battlefields of the War.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant at the Coal Survey Laboratory, Nottingham—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (May 20). A veterinary investigation officer at the University of Liverpool—The Registrar (May 24). A principal of the Technical College and School of Art, Colchester—The Director of Education, County Offices, Chelmsford (May 25). A science lecturer in the Yorkshire Training College of Housecraft, Leeds—The Director of Education, Education Department, Colverley Street, Leeds (May 28). An assistant in the Natural History Department of the Royal Scottish Museum, Edinburgh—The Director (May 31). A lecturer in geography and geology at St. Luke's College, Exeter—The Principal (May 31). An assistant lecturer in applied electricity and hydro-electric engineering in the University College of North Wales, Bangor—The Registrar (June 8). A lecturer in geography in Armstrong College, Newcastle-upon-Tyne—The Registrar. Assistant engineers for the Drainage and Irrigation Departments of the Governments of the Federated Malay States and Straits Settlements—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1.

Research Items

Abyssinian Games. In the course of two expeditions to Abyssinia (1928–29 and 1932), M. Marcel Griaule collected notes on more than four hundred games and recreations of the Abyssinians, of which he has published a selection (Bibliothèque de l'École des Hautes Études : Sciences réligieuses, **49**, Paris, Lib. Leroux, 75 fr.). They range from games involving the use of simple musical instruments and simple apparatus such as tops, balls, string, etc., to singing and dancing, games, rhyming, riddles and animal tales. Many of the games have a divinatory character, and it is noted that there is throughout Abyssinia a strong belief in the efficacy of children as agents of divination. Certain general principles are to be observed in the collection of games in Abyssinia. Between one district and another there may be a marked difference in the games played, or the rules of the same game may differ widely. The areas within which any variation obtains may be very restricted. In part this is due to the numerous strata of the peoples who have penetrated the country, and also to the consistent policy of the Abyssinians in enslaving and transporting peoples socially less highly organised than themselves. Further, the geographical configuration of the country is responsible for some variation, especially in those games which make use of plants. The high plateaux with their relatively cold climate are split up by low-lying valleys with a climate which varies rapidly in narrow zones from the relatively cold of the heights to tropical in the low-lying parts. The vegetation varies accordingly and with it the character of the games in which it has a function. The variation of climate may also affect the character of the games in other ways. It is, therefore, not sufficient to study the games as distributed by provinces. Their investigation must be highly localised. A further discrimination must be exercised in accordance with the season ; and in others the age and sex of the players has to be noted. The solemnity with which some of the games are played, and occasionally their long duration, as in the taboos of Carême, leave it beyond doubt that their origin is religious or magical.

Gulper Eels. The Carlsberg Foundation's oceanographical expedition round the world in 1928–30, and previous *Dana* expeditions under the leadership of Prof. Johannes Schmidt, have resulted in the acquirement of a vast amount of new and valuable oceanographical and marine biological data. Papers embodying the results of these various expeditions have appeared in a large number of scientific journals. Since the conclusion of the 1928–30 expedition, however, a series of special "Dana Reports" has begun to appear. These reports will continue to be published at intervals over a number of years and may be obtained from the Oxford University Press. *Dana* Report No. 3 on "Les Poissons Apodes apartenant au Sous-ordre des Lyomères" (the so-called gulper eels), by Leon Bertin, deals with the morphology, classification, and geographical distribution of the genera *Saccopharynx* and *Eurypharynx*. The relatively very comprehensive *Dana* collection of these fishes consisted of 5 individuals of *Saccopharynx* out of a total of 14 known specimens and of 59 *Eurypharynx* out of the 122 so far known. In the latter genus the author recognises (at least provisionally) two species, and in the former, four species, two being here described for the first time. The whole paper is based on the examination of adult fishes. A further memoir on larval and post-larval stages is promised.

Systematics of Rhizopoda. Henri de Saedeleer (*Mem. Mus. Roy. d'Hist. Nat. Belgique*, No. 60, 1934) divides the Rhizopoda according to the nature of their pseudopodia into three orders, the first two of which were already defined, Lobosa, Filosa and Granuloreticulosa, the third including Rhizopoda with filamentous pseudopodia which may exhibit many or few anastomoses and streaming of granules. This third order includes the suborder Athalamia, such as *Gymnophrys* ; Monothalamia, for example, *Allogromia* ; and Polythalamia, that is, the Foraminifera which are not included in this memoir. The characters of the further subdivisions—families, subfamilies, etc.—are followed by accounts of twenty-nine genera and fifty-eight species. From his studies on a large amount of living material from Belgium, from fresh water and from the seashore, the author has provided useful line drawings of most of the species. Four new genera and seventeen new species are described.

Empire-Grown Sisal for Marine Cordage. The Imperial Institute has recently published (February 1935. 1*s*.) a report upon tests carried out in conjunction with the Admiralty of tarred and untarred cordage made from East African sisal. As Manila hemp does not absorb tar satisfactorily, such cordage in the past has generally been made from European hemp. In order to investigate the effect of tarring on the durability of sisal cordage, the Admiralty has recently carried out a further series of experiments. Ropes, three inches in circumference, were prepared from East African sisal, one batch being made in the ordinary way from untreated fibre and another from yarn which had been passed through a bath of Archangel tar. Both kinds of rope were exposed to the action of sea-water for periods of two, four, six and nine months, their breaking strain being determined at the end of each period. It was found that after exposure to the action of sea-water for nine months, the untarred sisal rope had lost 76 per cent of its initial strength, whereas the strength of the tarred sisal rope had fallen only 29 per cent. The tests have thus shown that the life of sisal ropes when exposed to sea-water is enormously prolonged by tarring. The Admiralty is therefore considering the general adoption of tarred sisal cordage in place of tarred European hemp cordage, and inquiries are being made as to the extent to which such substitution could be carried out.

A Disease of Pomegranate. A short paper by H. Chaudhuri and Jagtar Singh (*Trans. Brit. Mycol. Soc.*, **19**, Part 2, 139–144, January 1935) describes a disease of pomegranate, *Punica granatum*, L., in Lahore, India, caused by the fungus *Amphichaeta punicæ*, n. sp. Infected twigs bore numerous pycnial fruit bodies ; and the tree was stunted, but seldom killed. Infection experiments proved that the causal fungus was a new species belonging to the genus *Amphichaeta*, for which the name *A. punicæ* has been suggested. Morphology, cultural characters, and the effect of various external factors on growth of the fungus are described.

An Earthquake Magnitude Scale. It is usual to estimate the intensity of an earthquake in terms of some arbitrary scale, such as the Mercalli or Rossi-Forel. The results may, however, be untrustworthy owing to variations in the nature of the ground, the depth of the focus or, in some cases, to the origin being submarine. In a recent paper (*Bull. Amer. Seis. Soc.*, **25**, 1–32; 1935), Mr. C. F. Richter shows that a comparison of the maximum amplitudes recorded at different epicentral distances by the Wood-Anderson torsion seismometers at the seven stations in South California makes it possible to estimate earthquakes as a whole in terms of a magnitude scale. The magnitude of a shock is defined as the logarithm of the calculated trace amplitude, expressed in microns, with which the seismometer would register that shock at an epicentral distance of 100 km. Such magnitudes can be assigned to the nearest half-unit or less. Shocks of magnitude 1·5 are just strong enough to be felt, those of magnitude 4·5 may cause slight damage near the epicentre, while those of magnitude 7·5 are at the lower limit of great earthquakes. For example, among recent Californian earthquakes, that of Long Beach in 1933 was of magnitude 6·2, and that of Nevada in 1932 of 7·5.

River Dee Flow Records. The brochure recently issued by River Flow Records (Parliament Mansions, Victoria Street, S.W.1) on the River Dee (Aberdeenshire) contains extremely serviceable information concerning the water-levels, rainfall and run-off in the basin of that river for the year 1934. There are four introductory statements of an explanatory character, dealing with the daily rainfall distribution, the Woodend flow-gauging station, the Cairnton water-level station and, finally, with the diagram records for the year. The diagram records, four in number, with a prefatory map, have been designed to obviate the publication of lengthy and numerous tables, and each of them covers a period of three months. The originals of the diagrams are $2\frac{1}{2}$ times the scale of the plates, and prints therefrom are stated to be available, if required. On the rainfall and run-off diagrams the aggregate run-off starts from zero on January 1 and amounts to 39 inches by the end of the year. The aggregate of rainfall starts with a credit of 0·39 inch, which is the minimum residual run-off for the water-level of January 1, under de-saturated conditions. The story of the year is briefly the desaturation of the early months, shown by excess of run-off, merging into the evaporation losses of the later spring; followed by the high evaporation losses of the summer and re-saturation losses of the early autumn, and ending with a see-saw of saturation and de-saturation during the late autumn and winter. There is an interesting appendix on the cost of river flow records, showing that an annual expenditure of about £100 will cover the whole scope of the work for a fully equipped flow-gauging station on rivers of 100 ft.–200 ft. in width. This expenditure falls roughly in equal proportions under four heads: interest on capital expenditure; maintenance, observations and tabulation; compilation of completed records; publication.

Combination Tones and Modulated Waves. H. Hazel (*Phil. Mag.*, Jan. 1935) has carried out some experiments which clarify the explanation of the famous Helmholtz-König controversy on the objective existence of combination tones. He shows that the addition of sinusoidal components, whether these are sound waves or wireless waves, does not produce combination frequencies unless the disturbances are impressed on a non-linear system. The multiplication of sinusoidal components (modulation) does give combination frequencies which can be detected by a linear arrangement, and if two sinusoidal disturbances are impressed on a non-linear system, 'product terms' are found in the motion of the latter which correspond to a modulation and hence to the production of combination frequencies.

Deuterium Content of Ordinary Water. Both the H/D (hydrogen to deuterium) ratio in ordinary water and the question of the existence or non-existence of the electrolytic separation of the oxygen isotopes have been subject to some doubt. H. L. Johnston (*J. Amer. Chem. Soc.*, **57**, 484; 1935) describes the preparation of deuterium-free water (less than 1 D atom to 10^6 H atoms) by electrolysis, and density determinations by a totally submerged float. The results correspond with an abundance ratio of 5750 ± 250 for H/D in ordinary water, which confirms the figure of 5000 ± 500 obtained by the mass-spectrograph by Bleakney and Gould. The electrolytic separation factor for O^{16} relative to O^{18} was found to be 1·008, which proves the futility of attempting to prepare pure O^{18} or O^{17} by electrolysis. From the H/D ratio of 5750 the atomic weight of normal hydrogen is calculated as 1·00795 on the O^{16} scale, or 1·00770 or 1·00775 on the chemical standard of O = 16, according to the abundance ratio of O^{18} of Manian, Bleakney and Urey, or of Mecke and Childs, respectively. These figures are based on Aston's figure of 1·00778 for H^1 and Bainbridge's value of 2·01363 for D. It may be remarked that Ingold and Ingold have recently reported an abundance ratio of H/D of 9000 (NATURE, **134**, 661; 1934).

Piperidine, the Alkaloid of *Psilocaulon absimile*. C. Rimington, research fellow under the Empire Marketing Board, reports the isolation of the toxic alkaloidal constituent of *Psilocaulon absimile*, N.E.Br., and its identification as piperidine hydrochloride (*S. African J. Sci.*, **31**, 184, Nov. 1934). The Aizoaceæ, of which *P. absimile* is a member, have on occasion caused the death of stock, but the chemical investigation of their constituents has received little attention. In the present investigation, a straightforward acid-alkali extraction process isolated the alkaloid, which was identified as piperidine by the preparation of the picrate, aurichloride and platinichloride. The picrolonate was also prepared. The pharmacological action of the salts on rabbits and frogs confirmed the chemical identification. The investigation has both chemical and botanical interest, since piperidine itself has not hitherto been found as a naturally occurring plant alkaloid. But the importance of th work lies in its possible economic application and in the additional evidence it provides of the wisdom of the policy of subsidising research which the Empire Marketing Board adopted. One pound of piperidine can be obtained from 10 kilos of the dried plant with the aid of such cheap chemicals as caustic soda, hydrochloric acid, chloroform and light petroleum. Piperidine has certain commercial uses, and the high cost of the synthetic substance offers scope for the commercial production of the natural alkaloid from *Psilocaulon*. It may be no more than a coincidence that the list price quoted in the paper is £6 8*s*. 0*d*. a lb. while to-day it may be obtained for £2 9*s*. a lb.

Cost of German Scientific Publications

THE high prices of German scientific publications, to which reference has been made in NATURE (132, 34 and 540; 1933), are again discussed in *Angewandte Chemie* of March 9. The chief factors in the increased cost are the decreased demand, increased cost of paper, binding, type and setting and illustrations, as well as overhead charges, decreased revenue from advertisements resulting from diminished circulation, the publication of smaller editions to avoid getting out of date, with consequent heavier on-costs, and the high discounts afforded to German booksellers. It is asserted that every effort is being made at compression to compensate for the 15–20 per cent greater space normally required for a German book as compared with the same work in French or English, and that the 'Münster Agreement' of 1933 (between librarians, publishers and the university unions, representing the authors) has in this way already resulted in an estimated decrease of 2,000,000 gold marks in costs of publication.

The prices of books and journals have been reduced, but only exceptionally has the cost per page been reduced, chiefly due to the technical costs of production which are not under the publisher's control. It is estimated that the cost of setting and printing is about 95 per cent above that of 1913; plates and line blocks are 60 and 150 per cent dearer, paper 12 per cent and bookbinding 100 per cent above the 1913 charges, representing an average increase of 50 per cent, or more for many important books. Author's fees have also increased, but are being reduced, and are now little above the pre-War figure. This factor, however, reacts adversely on the demand, since authors form an appreciable proportion of the purchasers of scientific works. During 1934, imports of foreign journals into Germany decreased 16 per cent in volume as against 12 per cent by value, indicating increased costs of production elsewhere, while exports of German literature decreased by 13·1 per cent in volume and 16⅓ per cent in value, indicating a fall in German prices.

On-costs in particular have increased both actually and relatively, and are still tending to rise owing to industrial conditions and diminished output. Publicity charges are more than 50 per cent higher than in 1913, taxation is at least four times as great, rents are 20 per cent, heating and lighting 27 per cent higher, and 20 per cent of the turnover in advertisements has to be contributed to the trade council. Postage charges are about 20 per cent higher and for such journals as *Angewandte Chemie* and *Die Chemische Fabrik* amount to 15 per cent of the total cost of publication. Salaries and wages are estimated at 25–100 per cent above the 1913 level. The size of editions is one of the most difficult problems confronting the publisher. Profits can only be made on sales in excess of a certain minimum, and to promote sales by diminishing costs, endeavours have been made to issue new editions of textbooks every seven or eight years instead of three or four years, but there are limits to such efforts imposed by the rapidity of scientific developments. Foreign sales have diminished enormously for political reasons as well as through increased competition, and for reasons similar to those operating internally. Advertisement revenue has assisted considerably in the reduction of the price of certain journals of applied science, but only amounts to about one third of the revenue from this source in 1929–30. Retail and wholesale booksellers in Germany demand a 25–30 per cent discount as against 15–16⅔ per cent abroad, and the trade is overcrowded. The reduction in the average price of German books from 8·36 to 4·32 gold marks in four years is largely due to the special cheap editions issued by the million, and is not reflected in scientific books, the purchasers of which have been heavily hit financially.

Increased purchasing power, decreased taxation and costs of production with further efforts at condensation are the only hopeful means of increasing the circulation. The American proposal to publish only the more important scientific papers, retaining the majority in manuscript and providing photostats as required, is severely criticised as fatal to publication of scientific knowledge and its effective circulation.

Copepods from West Greenland Waters*

AN important collection of pelagic copepods is described by Dr. P. Jespersen from the waters west of Greenland in the Davis Strait and Baffin Bay, with one station to the south-west of Iceland. The submarine ridge across the narrow part of the Davis Strait with a maximum depth of 700 metres forms an effective barrier to the migrations into Baffin Bay of many Atlantic species the habitat of which is deeper than this; the depths to the south of the ridge exceeding 3,500 metres and the depths in Baffin Bay amounting to at least 2,000 metres. Warm Atlantic water predominates in the sea area south of the Davis Strait, but along the west coast of South Greenland the East Greenland polar current makes its way round Cape Farewell, and in the most western part of this area there are several stations, taken by the expedition, situated in the cold Labrador current. A part of the Atlantic water passes over the submarine ridge in the Davis Strait and up into Baffin Bay, where it forms an intermediate layer below the surface with a positive temperature. The bottom water of Baffin Bay has on the contrary a negative temperature of about −0·4°. The temperature conditions alone thus form a natural limit to the northward advance of certain species.

The species are divided into two main groups: those which are found in the whole area investigated and those which are exclusively, or to a predominant degree, found in the waters south of Davis Strait; 23 species being found in the first and 76 species in the second division. Davis Strait thus appears to form the northern limit of distribution for a large number of Atlantic species, and it is specially those found in fairly great depths that cease to penetrate northwards and those more frequently caught in the upper layers which occur in the whole area. Most of the species are oceanic and no species were found

* Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige Undersøgelser i Grønland. Bd. 79, Nr. 10: The Godthaab Expedition 1928—Copepoda. By P. Jespersen. Pp. 166. (København: C. A. Reitzels Forlag, 1934.) 8.00 kr.

which in a pronounced degree are restricted to the Arctic sea areas. Indeed Dr. Jespersen states that "it is certainly a question whether among the oceanic copepods there are any distinct arctic forms at all".

The most frequent species were *Calanus finmarchicus*, *Calanus hyperboreus*, *Metridia longa* and young stages of the genus *Pareuchæta*. *Calanus finmarchicus* predominates in the hauls from the south of Davis Strait and the numbers are considerably reduced in Baffin Bay. In Smith Sound, much farther north, it is again abundant in the surface layers. *Calanus hyperboreus*, which likes cold water, is found only in small quantities south of Davis Strait, in the Strait itself in the upper layers being more abundant and in Baffin Bay present in small quantities. *Metridia longa* occurs in small quantities south of the Davis Strait and in the upper layers of the Strait itself, but occurs in fairly large numbers in Baffin Bay. *Pareuchæta* in its young stages is found in the water south of Davis Strait and only in small quantities in the Strait itself and in the more northern parts investigated.

Details of distribution and biology of all the species are given whenever possible with much interesting information, and many species are shown to have a more northerly distribution than was known before. A series of tables and curves is also provided. One new species was found, *Euchæta Wilsoni*, and this is represented by only one specimen.

All-Metal Radio Receiving Valves

IT will be recalled that about two years ago the 'Catkin' series of receiving valves was first produced in Great Britain (see NATURE, **131**, 735; 1933). In the construction of this valve, the amount of glasswork was reduced to a considerable extent, the upper portion of the envelope being formed of the cylindrical copper anode, which was sealed to the lower glass portion by a vacuum-tight joint. Now, an entirely new series of literally all-metal receiving valves is announced by the General Electric Co. of America, and brief details of these were given by the New York representative of the *Wireless World* in the issue of that journal of April 19. These new valves employ a cylindrical outer shell of steel or iron welded to a metal base which rigidly supports the electrode system. The lead-in wires from the electrodes are strung through beads of glass, which are then placed in eyelets of a new alloy known as Fernico, which lines the holes in the base of the valve. The assembly is then passed through a gas flame which fuses the glass beads so that they fill the eyelets. Fernico is an alloy of iron, nickel and cobalt which has the same coefficient of expansion as the beads of glass employed, so that the seal is accomplished without setting up strains in the fusing process. After the electrode system has been attached to the leads, the metal outer shell is placed over the structure and welded to the base. The valve is now exhausted through this metal tube, which is then clamped, welded and cut off at the appropriate time.

The use of an all-metal construction enables the valves to be made smaller in dimensions than existing glass valves, with corresponding reduction in lengths of leads and inter-electrode capacitances. The valves may therefore be of higher amplification factors without instability, and should retain their efficiency at shorter wave-lengths than existing types. Further, since the metal shell completely surrounds the valve and is maintained at earth potential, there will be no necessity for shielding the valve after it is placed in its socket in the receiver. At the present time, six types of all-metal valve have been put into production at the R.C.A. Manufacturing Co., which will make the valves for the General Electric Co. It is expected that new receivers designed round the metal valve will be produced by the autumn of this year.

Physical Methods in the Study of Earth Structure

THE increasing specialisation of science and its literature inspires an ever-growing demand for expositions of separate branches in terms suitable for workers in other fields. The effort to prepare such accounts is often beneficial to those who provide as well as to those who hear or read them; but some stimulus for their provision is needful, and notable among the available effective stimuli are the endowed annual lectureships of such bodies as the Institution of Civil Engineers. This is well exemplified in the forty-first James Forrest Lecture, delivered to that Institution on May 7 by Prof. O. T. Jones, who took geophysics as his subject.

The choice by a geologist to lecture on geophysics might in past years have led to a passionate or scornful attack on the geological ignorance of geophysicists; but even in this age of tolerance, Prof. Jones is notable among geologists for his sense of the importance of physical methods in studying the problems of the earth. He has, in fact, produced an admirably clear account of the subject, after modestly disclaiming any rôle save that of the exponent. So calm is the 'atmosphere' of his address that the geophysicist may even feel a craving for at least some more distinctively geological criticism or flavour. But in the closing part of the address Prof. Jones made a most interesting reference to a British problem that is of interest alike to geologists, geophysicists and engineers.

In many parts of the British Isles, Prof. Jones stated, there are known to be many deep rock channels that are so filled with various materials that their existence has not been suspected until engineering explorations for railways, roads, tunnels or sites for reservoirs have revealed them. Some of them are known to be post-glacial: others, being filled with glacial drift, must be pre-glacial. It is still uncertain whether these latter are due to normal river erosion, in which case their gradient must have been continuously downward to the sea-level of their period; or whether they have been excavated by streams flowing below the ice, in which case they

may be deep narrow channels with a rising gradient at both ends. Several of these channels are known in East Anglia; one seems to commence a few miles south of Cambridge, and follows approximately the line of the L.N.E.R. to Bishop's Stortford at least as far as Newport. It deepens rapidly southward, and if it is a normal river channel it must somewhere enter the sea, possibly following the Lea valley into the Thames estuary. If so, it might cause grave difficulty to engineering projects (as other such channels have done elsewhere), like that for a Thames tunnel east of the Lea valley. The buried channel of the Thames higher up is well known, but if the Newport channel does indeed enter the Thames estuary, its depth below sea-level would far exceed that of the known channel. It would therefore be of great interest both to geologists and engineers if such channels could be detected with certainty by geophysical methods.

The lecture briefly describes such applied geophysical methods, after discussing the scope of geophysics and the history and present position of the main 'pure' problems of geophysics. It should be added that the term geophysics is used in the lecture in a restricted sense: and such a remark as "geophysicists in this country do not concern themselves very much with the electric and magnetic field of the earth, which are observed in detail in various observatories", and the mention of the Carnegie Institution's Geophysical Laboratory without reference to the same Institution's great Department of Terrestrial Magnetism, must be interpreted as betokening unfamiliarity born of lack of personal interest in these further fields of geophysics.

History of Bitumen

TO-DAY, when petroleum with its vast range of derivatives is regarded as indispensable to the welfare of man, it is wholesome to be reminded of the salient factors which gradually extended its usefulness during the course of some five thousand years. It is equally salutary to have delineated handicaps of lack of knowledge, apparatus and facilities, which nevertheless were minimised by the ingenuity of ancient peoples who employed bitumen for a variety of purposes still recognised to-day.

A booklet entitled "The Story of Bitumen" (presumably by R. J. Forbes of Amsterdam, who last year contributed a similar article to the periodical *Bitumen* entitled "Aus der ältesten Geschichte des Bitumens") recently issued by Shell-Mex, Ltd., gives a brief account of the exploitation of bitumen from earliest records of its existence to about A.D. 1800. Abundant deposits were known even to the most ancient civilisations inhabiting the region between the Nile valley and that of the Indus, but production was necessarily confined to surface operations by lack of knowledge of the technique of deep drilling and absence of geological information on deeper oil or rock-asphalt deposits. At the end of the period reviewed, in spite of vicissitudes which hindered rather than accelerated growth of the industry, particularly at the time of the later Roman Empire, the majority of deposits of which we now have knowledge were actually known. Then, however, the importance of petroleum was negligible compared with present-day values, for the internal combustion engine which was later to give such tremendous impetus to the industry and create such a widespread demand for petroleum products was not yet discovered.

Records of actual production in ancient times are naturally scanty. It is obvious, however, that methods were extremely crude, as it is authentically reported that bitumen was recovered from the Dead Sea by men in rafts who simply 'hacked off' as large a piece of the floating mass as they could conveniently carry away. Similarly, until the eleventh century, only the most primitive attempts towards distillation were made: and this fact virtually excluded the use of light combustible oils. Gradually, however, more elaborate and practical methods were evolved, until at the beginning of the nineteenth century it may safely be said that the foundations of modern distillation technique were laid. Even so, no appreciable growth of the industry took place until after 1860, when deep drilling came within the realms of possibility. It is surprising, therefore, that in spite of all these handicaps and difficulties to easy production, we find bitumen was used extensively in antiquity as a building and road material, as a waterproofing agent and in various guises as a weapon in times of warfare. In comparatively recent times it was universally used also for lighting and heating purposes and as an ingredient of paints.

The booklet, in addition to tracing the story of bitumen, gives a chronological list of outstanding dates in the history of bitumen and includes a bibliography on petroleum and bituminous materials which, together with the numerous excerpts from early works quoted in the text, should provide a useful background to a historical study of the petroleum industry.

University and Educational Intelligence

BELFAST.—Dr. H. Barcroft, lecturer in physiology at University College, London, has been appointed to the Dunville chair of physiology in succession to Prof. T. H. Milroy, who is retiring on October 1. Dr. D. C. Harrison, lecturer in biochemistry in the University of Sheffield, has been appointed to the J. C. White chair of biochemistry, in succession to the late Prof. J. H. Milroy.

Colonel S. H. Browne, formerly of the Indian Medical Service, has bequeathed to the University £10,000 to found medical research scholarships.

CAMBRIDGE.—The Royal College of Veterinary Surgeons has intimated to the Vice-Chancellor that candidates who submit evidence that they are graduates in the Natural Sciences Tripos and that in the course of their examination they have passed in physiology, pathology, biochemistry and anatomy, may be exempted from the second examination conditionally on their passing the prescribed examination in animal management before the third examination.

At St. John's College, F. J. S. Hollick has been elected into a fellowship.

OXFORD.—The Halley Lecture will be delivered on June 5, at 5 p.m. in the Lecture Theatre at the University Museum by Dr. J. S. Plaskett, director of the Dominion Astrophysical Observatory, Victoria, B.C., Canada, who will take as his subject: "Dimensions and structure of the Galaxy."

Mr. J. N. L. Baker has been appointed University reader in historical geography for seven years from October 1. Miss B. M. Blackwood has been

reappointed university demonstrator in ethnology for one year from October 1.

A reader in statistics is to be appointed for five years from the first day of Michaelmas Term, 1935, the warden and fellows of All Souls having undertaken to provide a stipend of £600 a year for that period.

In continuation of his course of lectures on the scientific contributions of members of the Oxford colleges, Dr. R. T. Gunther, reader in the history of science, in a recent lecture directed special attention to the work of Robert Plot, John Radcliffe and Edmund Cartwright, all of University College, and respectively a great natural historian, a most munificent benefactor and an eminent inventor. At the same time the lecturer expressed his regret that the present Radcliffe Trustees should not have considered it their duty as managers of a charitable trust to preserve intact the historical scientific library of Prof. Stephen Rigaud, which they had purchased for far less money than it has now realised in a public sale-room.

UNEMPLOYMENT among young university graduates formed the subject of the deliberations of the Committee of International Students' Organisations at its meeting on April 10–11. As regards the possibilities of limiting the attendance of students at universities, the Committee urged that it would be both harmful and dangerous to endeavour to place restrictions on those who could rightly claim to attend the universities, and it disapproved of the imposition of a bar against women or against certain classes of the population on grounds of race or opinion. As a remedy for unemployment among intellectual workers, it recommended the establishment of university and professional information centres in the various countries, and suggested that public authorities or mutual aid societies should undertake the direction of certain branches of intellectual work for which private individuals have not the means to provide. Further, it suggested the adoption of measures by universities or student organisations for training young intellectual workers for their professions in country districts or colonies such as the 'social groups' in France, the 'educational missions' in Spain, or the 'frontier colleges' in Canada. Another recommendation was that bilateral or plurilateral agreements should be framed regarding the equivalence of university degrees, the exercise of professions abroad, and the employment of intellectual workers in foreign countries. The Committee urged international organisations of students and intellectual workers to consider the possibility of establishing an international organisation for securing work on the basis of the general information which might be supplied by the International Labour Office.

Science News a Century Ago

University of London

On May 18, 1835, *The Times* said, "Yesterday the annual distribution of the medals and prizes to the successful candidates in the medical and surgical departments took place at the London University; Lord Nugent presided on the occasion. . . . Immediately after the distribution of the prizes the Chairman rose and addressed the company. His lordship had been about three years from London. At his departure the London University was in a state of infancy; at his return he had been highly gratified on finding that it had made so rapid a growth towards maturity. Mr. Thomas Campbell, who had first suggested the foundation of the present establishment, had said, that only two capital cities of Europe had been without universities, London and Constantinople. The reproach was now removed from London, in which two most useful institutions flourished, not in a spirit of opposition to each other, but in a spirit of laudable emulation and generous rivalry."

Progress of Mechanics' Institutions

At the anniversary meeting of the London Mechanics' Institution (now Birkbeck College) held on May 20, 1835, the president, Dr. Birkbeck, is reported to have said that "This establishment was still flourishing, and those elsewhere were becoming more numerous and more prosperous. The most remarkable circumstance connected with the prosperity of mechanics' institutions was the establishment of one at Cambridge, which had received the approbation and patronage of all the great and the wise of that distinguished seminary of learning. . . . Endeavours had been made to establish a mechanics' institution at a place near Bolton, but he (Dr. Birkbeck) had received a letter from the person who made the attempt, stating that the mean rate of wages was only 7*s*. a week, and although the subscription had been dropped from 10*s*. a year to 6*s*., he could get no subscriptions, nor any donations. . . . At Manchester and Liverpool, however, the progress of these institutions had been great. . . . The number of members belonging to the metropolitan institution was 1,123 exclusive of honorary members; that of Manchester, including honorary members, was 1,232, and that of Liverpool including honorary members, was 1,206."

Theory of Respiration

At a meeting of the Royal Society on May 21, 1835, Dr. William Stevens read the concluding portion of his paper on observations on the theory of respiration. After reviewing the author's remarks on the interaction of the air and the blood and the experiments with which the paper was accompanied, the report in the Society's *Abstracts* said: "According to these views it is neither in the lungs, nor generally in the course of circulation, but only during its passage through the capillary system of vessels, that the blood undergoes the change from arterial to venous; a change consisting in the formation of carbonic acid, by the addition of particles of carbon derived from the solid textures of the body, and which had combined with the oxygen supplied by the arterial blood; and it is by this combination that heat is evolved, as well as a dark colour imparted to the blood. The author ascribes, however, the bright red colour of arterial blood, not to the action of oxygen which in itself is completely inert as a colouring agent, but to that of the saline ingredients naturally contained in healthy blood. On arrival at the lungs, the first change induced in the blood is effected by the oxygen of the atmospheric air, and consists of the removal of the carbonic acid, which had been the source of the dark colour of the venous blood; and the second consists in the attraction by the blood of a portion of the oxygen, which it absorbs from the air and which takes the place of the carbonic acid."

Societies and Academies

PARIS

Academy of Sciences, April 1 (*C.R.*, 200, 1161–1256). PAUL LANGEVIN : A suggested experiment of M. Dufour. This experiment was suggested as one capable of differentiating between classical kinematics and that of limited relativity. A mathematical analysis shows that, in the form laid down by M. Dufour, the experiment would fail to detect any difference. A modification is suggested by the author, which is theoretically capable of detecting the difference, but in practice it cannot be carried out. ERNEST ESCLANGON : Experimental researches on the optical dissymmetry of space. JULES HAAG : The algebraic structure of the admittances of a filter as a function of the frequency. FLORIN VASILESCO : The continuity of the potential through masses and the demonstration of a lemma of Kellogg. GHERMANESCO : Exceptional homogeneous combinations of integral functions. ANDRÉ FORTIER : The kinematics of flow round profiles with hyper-sustaining arrangements. ADRIEN FOCH and CHARLES CHARTIER : The flow of a fluid below a sphere. PIERRE LEJAY and TSANG HUNG-CHI : Observations of the intensity of gravity at the centre of China. Table of results from sixty-five stations, showing the reduced values of g and the corresponding anomalies. LUCIEN BULL : A liquid string galvanometer. A modification of the string galvanometer, using a thread of water of 0·3 mm. diameter. CH. LAVANCHY : General method of calculation for electrical networks. PIERRE GIRARD and PAUL ABADIE : The detection of molecular interactions by the relaxation time of polar molecules. ANDRÉ CHARRIOU and MLLE. S. VALETTE : The influence of the cations on photographic emulsions. MLLE. CÉCILE STORA : The action of gases (hydrogen, nitrogen, oxygen) on photo-cells with colouring matters. MLLE. YVETTE CAUCHOIS : Study of the L spectrum of mercury. C. G. BEDREAG : The place of protons and neutrons in the natural systematics of the elements. B. KURTCHATOV, J. KURTCHATOV and G. LATYCHEV : The disintegration of boron by slow neutrons. The vapour of methyl borate was acted upon by slow neutrons and the effects followed by the Wilson method. The photographs show that the disintegration was accompanied by the emission of two heavy particles and not three as found by Chadwick and Goldhaber. B. KOURTCHATOW, I. KOURTCHATOW, L. MYSSOWSKY and L. ROUSSINOW : An example of artificial radioactivity, produced by bombardment with neutrons, without capture of the neutron. GEORGES WOLF : Study of the binary system strontium nitrate – strontium hydroxide. E. RINCK : Solidification diagrams of the alloys formed by two alkali metals ; the potassium-rubidium alloys. FRANÇOIS PUCHE : The thermal decomposition of the chloride and chlorosalts of palladium. MAURICE CHAIX : The ultra-violet absorption spectra of derivatives of diphenylene sulphide and diphenylene-sulphone. HENRI GUÉRIN : The reduction of the arsenates of the alkaline earths by carbon. Tricalcium and tristrontium arsenates. GUY GIRE : The formation of basic sulphate and the precipitation of nickel in solution by magnesium. PIERRE CARRÉ and DAVID LIBERMANN : The reaction of thionyl chloride and phenylglycollic acid. M. TIFFENEAU and P. WEILL : The hydrobenzoin dehydration of phenylethenylglycol. The formation of α-phenylcrotonic aldehyde. VICTOR HARLAY : Some silver compounds of thiosemicarbazide and of the thiosemicarbazones. FRANÇOIS SALMON-LAGAGNEUR : Some reactions of the chloride of the α-mononitrile of camphoric acid. ISSAC KOGA and MITSUO SHOYAMA : The frequency-temperature characteristics of quartz plates oscillating with zero temperature coefficient. J. FRANC DE FERRIÈRE : The history of the loess soils of the Rhenish terraces in Haute-Alsace. LOUIS and HENRI LONGCHAMBON : The extension of the Toarcian hydrocarbon facies in the east of France. CH. COMBIER : The constitution of the sand winds in Syria. ROBERT GIBRAT and GEORGES VIEL : The relation between the electrical conductivities of the air and the danger arising from lightning. R. GUIZONNIER : The amplitude of the semidiurnal component of the gradient of terrestrial electric potential and solar activity. MME. C. SOSA-BOURDOUIL : Physiological researches on the parents and hybrids of the bean, *Vicia Faba*. MAURICE MARIE JANOT : The action of folliculine and equilenine on the development of the hyacinth. JOSEPH and CHARLES BOUGET : Cultures of tubers obtained by the germination of seeds of potato raised in the mountains in 1933. ROBERT ECHEVIN : The absorbing power of soils towards magnesium chloride. LOUIS MAUME and JACQUES DULAC : The C/N ratio in the wheat plant at heading and flowering : its marked variations with the medium. JAMES BASSET, EUGÈNE WOLLMAN, MICHEL A. MACHEBŒUF and MICHEL BARDACH : The biological effects of ultra-pressures : the action of high pressures upon tumours. MLLE. HENRIETTE GARRAULT : The formation of rods of elastoidine in embryos of Salmonidæ. P. LECOMTE DU NOÜY and MLLE. VIVIANE HAMON : A new method of estimating the diphtheria antitoxin by the viscosity. RENÉ LEGROUX and ANDRÉ LWOFF : The schizogonic evolution of the macrogametocyte of *Hæmoproteus paddæ*. FRÉDÉRIC DIÉNERT : Study of the clarification of water by micro-organisms. PAUL GIROUD and HARRY PLOTZ : Crossed immunity between cultures of historic exanthematic typhus (murin) and the virus of passage.

CRACOW

Polish Academy of Science and Letters, March 4. M. WOLFKE : The effective section of the neutrino. Starting with the measurements of Chadwick and Lea, and taking account of the ionisation by the secondary electrons, the free path of the neutrino in normal air is about four million kilometres, corresponding to an upper limit of the effective section of the neutrino of about 7×10^{-33} cm.^{2}. MLLE. S. SZAFRANSKA : The viscosity of mixtures of hexane and nitrobenzene in the neighbourhood of the critical temperature of solution. The isothermal lines of the viscosity of mixtures are quite regular in the region not showing the phenomenon of opalescence. This is not in agreement with the results obtained by Drapier and it is suggested that these irregularities were due to Reynolds's condition not being fulfilled. B. KAMIENSKI : A method of measuring the dielectric potentials at the surface of separation of the phases solution : air. A dynamical method is employed, the solutions flowing concentrically together. Owing to the surfaces being continually renewed, the results are more constant than those obtained by the static method. L. MARCHLEWSKI and J. SKULMOWSKI : The absorption of ultra-violet rays by certain organic substances (38). L. MARCHLEWSKI and W. URBANCZYK : Studies of some chlorophyll derivatives.

M. KSIAZKIEWICZ: Zone of the Carpathian klippes in the neighbourhood of Andrychow (2). The klippes of Panska Góra and of Targanice. W. SZAFER: The forest and steppe of the western part of Podolie. A. BURSA: List of the Algæ collected in the waters of the Polish shore of the Baltic. MLLE. M. SKALINSKA: Cytogenetic studies on a tetraploid hybrid of *Aquilegia*. T. SULMA: Remarks on the ecology and distribution of the lichens in the Lublin plateau. MLLE. J. WOLOSZYNSKA: Some remarks on *Attheya decora*, a very rare plankton diatom. MLLE. J. WOLOSZYNSKA: The efflorescence of the Cyanophyceæ in the gulf of Gdansk, and the abundant development of the diatom *Chaetoceros Eibenii*.

LENINGRAD

Academy of Sciences (*C.R.*, 1, No. 4; 1935). N. ROMANOV: The possibility of connecting the Pavlov theory of conditioned reflexes with the theory of probabilities. I. PRIVALOV: Some problems of the theory of subharmonic functions (1). L. KANTOROVITCH: Continuation of linear functionals. K. NIKOLSKIJ: Relation between the field equations of Born-Infeld and Dirac's quantum equation. E. GROSS and M. VUKS: The Raman spectrum of amorphous bodies. L. GROSHEV: The crystal photo-effect in naturally coloured rock salt. K. ANDREJEV: The burning of explosives. S. NAMETKIN and N. MELNIKOV: Contribution to the chemistry of organic compounds of thallium. J. ELLENHORN, A. PROKOFJEVA and H. J. MULLER: Optical resolution of chromosomes of *Drosophila* by means of ultra-violet light. P. TERENTJEV: Contribution to the problem of the real significance of the Pearson type of distribution curves in the case of biological objects. E. WERMEL and M. MICKEVICH: Influence of hormones on the growth of tissue cultures. A. LINDBERG: Influence of caffein on the activity of the outer layer of the cerebral hemispheres. S. KAGANOVSKAYA and A. SHLYKOVA: Influence of potassium chloride and calcium chloride on the respiratory metabolism of nerves. L. YAKUBOVA: The biogeographic division of the Black Sea on the basis of composition and distribution of its centhos fauna. S. TARANETZ and A. ANDRIASHEV: A new fish of the family Zoarcidae from the littoral fauna of the Commanders' Islands.

VIENNA

Academy of Sciences, March 7. JOVAN JURIŠIĆ: Morphology and teratology of the blooms, and propagation, of *Bryophyllum crenatum*, Baker. KARL PRZIBRAM: Fluorescence of fluorite (5). Fluorescence of europium dichloride, and alkali halide-europium phosphors. Pure europium dichloride shows a bright purple fluorescence; the spectrum exhibits the blue fluorite bands and, in the red, a narrow line-like band at 690 mμ and a paler one at 630 mμ, corresponding with that given by fluorites. As previously supposed, the blue bands of fluorite are those of bivalent europium, and the same is probably the case for the red bands. Europium may be rendered capable of fluorescence by incorporation in alkali halides, and then shows, after radium irradiation or heating, the red and blue bands; the latter serve as a sensitive indicator for europium. G. NATTA, M. BACCAREDDA and R. RIGAMONTI: Electron diffraction as an aid to the determination of the structure of organic substances. KURT EHRENBERG: Comparative studies of juvenile skulls and milk-teeth of the cave hyena and its recent relatives.

Forthcoming Events

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

Sunday, May 19

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Fossil Reptiles".*

Monday, May 20

ROYAL GEOGRAPHICAL SOCIETY, at 5.—J. Wright: "The Hagavatn Gorge, Iceland".

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY, at 5.30—(London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1).—Prof. Major Greenwood: "Temperaments Physical and Psychological in Modern Science".*

Thursday, May 23

ROYAL SOCIETY, at 4.30.—Prof. J. Barcroft: "Foetal Respiration" (Croonian Lecture).

ST. MARY'S HOSPITAL, LONDON, at 5.—Dr. C. H. Andrewes: "The Cancer Problem: Some Fresh Clues".*

CHADWICK PUBLIC LECTURE, at 5.30.—(in Manson House, 26 Portland Place, W.1).—Miss Noel Tidy: "Physical Exercises: Educational and Preventive".*

CHEMICAL SOCIETY, at 8.—Prof. J. E. Coates: Haber Memorial Lecture.

Official Publications Received

GREAT BRITAIN AND IRELAND

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1621 (S. 178): Cine-Photographic Measurements of Speed and Attitude of Southampton Aircraft when Taking Off and Alighting. By A. E. Woodward Nutt and Dr. G. J. Richards. Pp. 13+7 plates. 1*s.* net. No. 1623 (T. 3488): Effect of Discs on the Air Forces on a Rotating Cylinder. By Dr. A. Thom. Pp. 10+7 plates. 9*d.* net. No. 1626 (T. 3534): Interference Effect of Surface of Sea on a Flying Boat. By W. L. Cowley and G. A. McMillan. Pp. 15+8 plates. 1*s.* net. No. 1627 (T. 3586): Tests of Six Aerofoil Sections at Various Reynolds Numbers in the Compressed Air Tunnel. By E. F. Relf, Dr. R. Jones and A. H. Bell. Pp. 28+6 plates. 1*s.* 6*d.* net. (London: H.M. Stationery Office.)

OTHER COUNTRIES

Merentutkimuslaitoksen Julkaisu: Havsforskningsinstitutets Skrift. No. 98: The Thalassological Summer Cruise in 1934. By E. Palmén. Pp. 17. No. 99: Vedenkorkeusarvoja 1933 (Vattenståndsuppgifter 1933). By S. E. Stenij. Pp. 52. No. 100: Regular Observations of Temperature and Salinity in the Seas around Finland, July 1933–June 1934. By Gunnar Granquist. Pp. 45. (Helsinki: Merentutkimuslaitos Havsforskningsinstitutet.)

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 21, No. 20: The Templeton Crocker Expedition of the California Academy of Sciences, 1932. No. 20: The Termites. By S. F. Light. Pp. 233–256+plates 9–10. No. 21: The Templeton Crocker Expedition to Western Polynesian and Melanesian Islands, 1933. No. 21: Some Marine Plants of Southeastern Melanesia. By William Albert Setchell. Pp. 259–270+plates 11–15. (San Francisco: California Academy of Sciences.)

Zoologica. Vol. 19, No. 1: The Distribution of Certain Whales as shown by Logbook Records of American Whaleships. By Charles Haskins Townsend. Pp. 50+4 plates. Vol. 19, No. 2: The Vampire Bat; a Presentation of Undescribed Habits and Review of its History. By Raymond L. Ditmars and Arthur M. Greenhall. Pp. 53–76+plates 5–7. (New York: New York Zoological Society.)

U.S. Department of Commerce: National Bureau of Standards. Research Paper RP 756: A Maxwell Triangle yielding Uniform Chromaticity Scales. By Deane B. Judd. Pp. 41–57. (Washington, D.C.: Government Printing Office.) 5 cents.

Ceylon: Sessional Paper 4.—1935. Report and Accounts of the Coconut Research Scheme for 1934. Pp. 11. (Colombo: Government Record Office.) 15 cents.

CATALOGUES

A Catalogue of Rare and Interesting Books, XVIIth and XVIIIth Centuries and onwards. (No. 474.) Pp. 36. (Cambridge: Bowes and Bowes.)

General Catalogue of Books, with a selection of Atlases and Maps. (No. 585.) Pp. 98. (London: Francis Edwards, Ltd.)

Catalog and Price List of Eastman Organic Chemicals. Twenty-sixth edition. 112. (Rochester, N.Y.: Eastman Kodak Co.)

The Salermo Process and the Extraction of Oil from Oil Shales and Torbanites. Pp. 24. (London: Salermo, Ltd.)