Editorial & Publishing Offices :
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3552 SATURDAY, NOVEMBER 27, 1937 Vol. 140

Defence and Economic Adjustment

THE recent debate in the House of Commons on the second reading of the Air Raid Precautions Bill brought into clear prominence the close contact between the work of chemists and other men of science and protection from its devastating consequences under the conditions of modern warfare. Mr. G. Lloyd, Under-Secretary of the Home Office, made a comprehensive survey of the measures taken by the Government, and in course of development, to provide the civilian population with whatever means of defence is practicable against effects of air raids. The object of his Department is to make the community as a whole, as well as individual citizens, aware of the dangers of high explosives, toxic gases and incendiary bombs set free from enemy aircraft, and to institute reasonable precautionary measures against them. Possibly some of these anticipated dangers are exaggerated, especially that from gas, but it would be folly to disregard them ; but for psychological reasons the people of the country must be given a certain amount of confidence in protective measures in order to prevent them from becoming panic-stricken. Even although it is sometimes difficult to distinguish between the necessity of expenditure upon increased armaments and that of defence programmes, it is in the interest of everyone that whatever precautionary measures are planned or contemplated should be as efficient as science can make them.

The attitude which chemists and other scientific workers should take in regard to the manufacture of munitions of war has been discussed on many occasions, but opinions upon it vary as much among them as they do among citizens in general. The suggestion put before the Technical Committee of the Disarmament Conference that the chemists of the world should include in their code of ethics an undertaking not to work knowingly on the development and production of any prohibited method of warfare, and to expose publicly anyone who was detected in such work, is altogether impracticable. Chemists are citizens as well as men of science, and their services should, therefore, be available for what is regarded as the good of the community. At all stages of human history men have used for purposes of war the most effective means of destruction known to them ; and there is little difference in principle in the employment of Greek fire many centuries ago and the use of incendiary bombs to-day. Even in those days boiling oil and molten lead were used as measures of defence against attacks on the walls of cities as well as of fortresses.

The scientific worker cannot stand apart, therefore, from reasonable and practicable steps taken towards the protection of the civil population from aerial attacks. He, with many others, may deplore the loss of his faith in the progressive ethical development of the human race, but his natural humanity must make him play his part in endeavours to prevent suffering and death.

While, however, we in Great Britain are planning and undertaking a defence programme which will cost many millions of pounds, it should not be forgotten that France, Germany and other nations have instituted similar protective measures against aerial attacks by other nations—ourselves included. As it may be assumed that most people wish to carry on their work in peace and to promote the industry and commerce of their country, such a condition of things is a reproach to human intelligence. It represents the acceptance of a

policy of despair of avoiding war instead of attempting to discover the causes which lead to armed conflict. Fortunately, efforts are being made in several quarters to promote inquiries into such causes before appeals are made to force. In a petition presented by a deputation to the Prime Minister on November 1, it was urged that H.M. Government should take the initiative in instituting an inquiry into the fundamental causes of rivalry and unrest among nations. More than one hundred fellows of the Royal Society were among the influential signatories of this petition. They, in common with many other distinguished representatives of other fields of intellectual activity, are horrified at the barbaric ways in which progressive scientific knowledge is permitted to be used in operations of war, and associate themselves with any action which may assist in preventing such calamities.

It was suggested by the petitioners that the inquiry might involve the collection and consideration of the basic facts in regard to such questions as access to war materials and world markets, colonial development, problems of surplus populations, and so on, which are often discussed without adequate knowledge and judged without evidence. Though some countries may decline to participate in such an inquiry, or be influenced by the results, it would represent a search for some means of reconciling conflicting national claims and thus make manifest the desire to promote peace on a secure and just foundation. In his speech at the Lord Mayor's banquet on November 9, and again in an address at Edinburgh three days later, the Prime Minister expressed his active interest in efforts of this kind to inquire into the origin and substance of the fears and suspicions which exist among nations, with the view of removing them. "Our country," he said, "has behind her vast, almost illimitable resources, and our very strength makes it easier for us to appeal to others to join in applying our common-sense, our common humanity, to the solution of those problems which carry with them such tremendous possibility for happiness or for misery to the future of the human race. I have faith in human nature. Because I have that faith I believe there will be a ready response to such an appeal."

The economic commission suggested by King Leopold of the Belgians a few months ago would have the same objects as those to which the Prime Minister referred. At the Guildhall on November 17, responding to the toast proposed by the Lord Mayor of London, King Leopold expressed the hope that Great Britain would take a prominent part in inquiring into the economic difficulties which lie at the root of the international problems which beset the world. "In order to solve those difficulties," he said, "we should need to get a clear view of economic realities seen with a dispassionate eye and divorced from every other consideration. The British Empire represents so important a part of the human race that it cannot help but realize more clearly than any other nation how closely the fate of mankind is bound up with its own. That is why your understanding of the great universal problems is so profound and why it is permissible to be hopeful that Great Britain may play a prominent part in the search for a solution of the major economic difficulties." Questioned upon the subject of this appeal in the House of Commons on Monday, the Prime Minister said that he was glad to have an opportunity of responding cordially to it on behalf of the Government, which, he said, are "fully prepared to play their part in the search for a solution of the world's major economic difficulties".

The Anglo-American trade agreement, which, after months of informal conversations, has now reached a stage at which, as announced by the Prime Minister in the House of Commons on November 18, definite steps can be taken towards actual negotiation of terms, is an example of what can be done by the joint discussion of national problems; and its political implications are as important as its economic interests. It is by the application of scientific methods and of the scientific spirit in these fields that there is hope of discovering the causes, and averting the consequences, of international disputes. Though the impartial and responsible study of some of the international economic and racial problems of to-day may not satisfy some national claims, it would in any event make the civilized world understand whether or no national passions had been aroused in a just cause. Instead of waiting for war and at the end of hostilities inquiring into the causes which led to it, and adjusting the consequences in the bitterness of spirit which must then prevail, let us urge that every opportunity should be taken to promote full and frank inquiries into economic or other restrictions or grievances, so that a certain amount of attention may be diverted from preparation for offence or defence in war to the discovery of the conditions of creative peace.

Science in Psychology

Psychology down the Ages

By Prof. C. Spearman. Vol. 1. Pp. xi + 454. Vol. 2. Pp. vii + 355. 8vo. (London: Macmillan and Co., Ltd., 1937.) Two vols., 30*s*. net.

ABOUT the beginning of the present century, psychology began to emerge from the kind of chrysalis state in which it was lying dormant and cramped in the cocoon of associationism, and to become a natural science. Even so lately as 1890 no less a psychologist than William James, who made a valiant attempt to break away from the fetters of the system in which he had been trained, brought his "Principles" to an end with the words: "Even in the clearest parts of psychology our insight is insignificant enough. And the more sincerely one seeks to trace the actual course of *psychogenesis* . . . the more clearly one perceives 'the slowly gathering twilight close in utter night'." Not only here did he strike the same pessimistic note. In his "Briefer Course" he concludes in the same strain: ". . . not a single law in the sense in which physics shows us laws, not a single proposition from which consequences can causally be deduced. . . . This is no science, it is only the hope of a science". What a confession to be obliged to make!

But some ten or fifteen years after those words were written by one of the then greatest living psychologists, there came a stirring into life of the apparently dead, and certainly quiescent, pupa. I say pupa, but there must have been more than one of these; for no fewer than six important systems of psychology sprang into being at about the same time, all of them (save one) showing signs of a profound metamorphosis. Of these, in this notice, we are concerned with that of Charles Spearman, whose psychological principles and theories are now probably better known and more highly appreciated in the academic world than those of any other contemporary psychologist. This was not so when Spearman first published the results of his researches into the nature of intelligence. It was not so when, in a series of papers dating from 1904, he gave forth his mathematical conclusions as to the joint operation of two factors in every cognitive activity. At first there was much dissention and criticism. But all this has now for the most part subsided; and the most trenchant of the erstwhile critics have adopted his mathematical treatment of psychological data, and are busily extending it to cover temperamental and character qualities as well as cognitive ones. Moreover, the noegenetic (knowledge originating) principles of the apprehension of experience, the finding of relations within apprehended experience, and the extension of knowledge even beyond experience, so obviously account for the observed facts that, like Newton's laws of movement, they can scarcely be gainsaid. Some critics have objected that these principles are logical rather than psychological; but a like criticism might as well be urged against Newton's laws. They also are logical; if they were not they could scarcely be rational, or in any sense explanatory.

Apart from his contributions to psychological, educational, statistical and other journals, Spearman has published two outstanding, and even, as a former reviewer called one of them, "epoch-making" works ("The Nature of Intelligence and the Principles of Cognition", 1923; "The Abilities of Man", 1927). In these he developed his own theories, and substantiated them by the results of a large number of researches carried out under his direction by his numerous students in the laboratory of University College, London, as well as by those of many other investigators elsewhere. The researches he himself directed clearly were governed from the outset by a definite plan. They all converge upon the problem he had originally set himself, namely, to discover what it is that makes for ability in mental effort. In these two volumes he expanded and developed the qualitative laws of noegenesis, together with the quantitative laws of mental energy, retentivity, fatigue, control, and the basic conditions of all mentation. By means of these two sets of laws, he claims, it is possible to account for every sort of knowing, whether original or subsequential. In these works also he gave convincing evidence for the 'Two Factor' theory, which requires the co-operation of a general and common factor that is involved in every mental operation, together with special factors that are restricted to each different kind of cognitive process. But in them he did not especially show the immense acquaintance with psychological literature, ancient, medieval and modern, which must have been in the background of his mind throughout. In "Psychology down the Ages" this becomes apparent. Nor did he in the previous works more than lightly touch upon the "orectic" side of the mind. In the present work, this is much more amply treated, especially with regard to volition, emotion and psychological types of character and temperament.

In a sense the present two volumes should have been the first to appear. They do not constitute a history of psychology in the usual meaning of the word; but they show how psychology has advanced from the primitive conceptions of the animists, through the ruminations of the philosophers, to win the status of an empirical science. They show, too, how much has been forgotten and rediscovered, how many mistakes have been made, and how, despite them, psychology has advanced like a slowly flowing tide. To change the metaphor, as Spearman writes in his prologue, "we hope to indicate the chief assets, as also liabilities, which have been accumulated, and so to draw up a fair and square balance sheet". This aim he has certainly accomplished.

Beginning with a section which deals with the subject-matter and scope of the science, Spearman next examines the operations and constitution of what he, disregarding the misleading (because theologically and metaphysically contaminated) terms like 'soul', 'mind' and 'consciousness', calls the 'psyche', and goes on to the establishment of genuine psychological laws (sequences) which, like any other scientific laws, explain the data to be explained, and also, when known and applied, permit of both the prediction and the control of events.

The final section of the work deals with concomitances: 'What goes with what?' This is a matter of statistical evidence; and here the old 'faculty doctrine' is put upon its right footing. It cannot be assumed that, because a name, like 'memory', 'sense' or 'intellect', is given to a presumably unitary, psychological function, such a function is in fact unitary. Indeed, experiment has shown that there are different kinds of 'memories'; and it is obvious that one cannot infer an acuity of one sense from the acuity of another. One may have an excellent sense of touch and a very poor one of hearing, or an exquisite appreciation of odours, and yet be totally colour-blind. These faculty 'concomitances' have to be proved, not assumed; and the only way of proving or disproving them is that of correlation. It is perhaps Spearman's chief achievement that he has forced psychologists to recognize this. Piling up introspective or observational data with no instrument for dealing with them is a thankless task, and leads nowhere in science. For centuries people have made introspections (to say "I am angry, or hot, or interested" is to report the result of an introspection); but no laws have resulted from them alone. Treating data, the significance of which is not known, statistically, may yield coefficients of correlation but by itself is meaningless and nonsensical. It is only the marriage of these two methods that yields a legitimate and healthy offspring, in the shape of principles or laws.

"Psychology down the Ages" is an eminently sane, judicious and scientifically balanced work, easy to read and understand, and (to borrow the words of a reviewer of a former work of Spearman and apply them to this) the "most distinguished British contribution to experimental psychology that has been made in recent years". Indeed, both in comprehensiveness and clarity, it excels "The Abilities of Man".

F. AVELING.

Intermediate Chemistry

Intermediate Chemistry

By Prof. T. M. Lowry and A. C. Cavell. Pp. xvi + 880. (London: Macmillan and Co., Ltd., 1936.) 12*s*. 6*d*.

AS the title indicates, this book is written expressly for the student preparing for an Intermediate examination in chemistry, and it should fulfil its purpose excellently.

It is comprehensive within its field, and so, after the usual general theory and descriptive inorganic chemistry have been dealt with, very faithfully, in the first half of the text, there follow three further sections dealing respectively with analysis, with physical chemistry and with the broad principles of organic chemistry. Thus, within one cover (which, with typical thoughtfulness and good sense, is made waterproof) we have assembled all that the Intermediate student requires—the equivalent of three or four other books. It is remarkably good value for money.

Good value, too, in quality: every section gives a precise and remarkably full account of its subject from a thoroughly modern point of view. Indeed the one possible adverse criticism seems to be that the matter given, especially perhaps in the physical part, is needlessly extensive and more than the average first-year student can assimilate. Such criticism, however, would be unsound: it is surely desirable, even though a young student cannot be expected to remember all that is here, that the residue which does stick, whatever general sense of chemistry he gains, should be derived from reading an account of chemistry which takes a properly generous view of his intellect and interest.

The authors have adopted the very sound view that it is the teacher's job to make chemistry alluring and theirs to write a plain, unvarnished tale, with every fact and argument so clearly delineated that the apt student may discover for himself the beauty of the science. It is not least among the many merits of this book that from its concise, plain English, delightfully free from any looseness or ambiguity of thought or statement, he will learn more than chemistry.

There are so many features one would like to commend in detail, for example, the chapters on the structure of matter and the electronic theory of valency, or the large and useful collection of questions at the end (with answers), that it is impossible in a brief review to deal with the book in this way. It must suffice to say that it should be possessed and studied by every serious student or teacher of chemistry.

H. V. A. BRISCOE.

That Leviathan

Giant Fishes, Whales and Dolphins

By J. R. Norman and F. C. Fraser. Pp. xxviii + 361 + 8 plates. (London and New York: Putnam and Co., Ltd., 1937.) 15*s*. net.

"NOW the Lord had prepared a great fish to swallow up Jonah." The interminable debate goes on among dabblers in textual criticism as to whether it was a whale or a fish that engulfed the prophet. At best the discussion has been scientifically of a low order, but there is no longer any excuse for vagueness now that J. R. Norman and Dr. F. C. Fraser have gathered all the possibilities (barring those of special creation) into one compact volume.

Here are assembled under one roof, so to speak, all the great denizens of the sea, both fish and whale, together with their respective dependants and victims. A concise introduction elucidates the chief points of difference between fishes and whales. Their comparative anatomy, modes of reproduction and habits are described. Fortunately, this section is short enough to enable inquirers to find what they want by reading through the text, since the indexing of this section, in Roman numerals, leaves much to be desired.

Then follows Norman's account of the giant fishes, beginning properly with the most ancient order, Selachians, among which are to be found the most savage and bulky fishes. Sharks and rays are clearly described and differentiated. Their distribution, breeding habits, and relative voracities are touched upon, usefully dispelling the prevalent notion that all sharks are ferocious man-eaters. The author recalls that the reward of 500 dollars offered for an authentic case of a man having been attacked by a shark in temperate waters was never claimed. The description of seventeen different sharks is agreeably leavened by anecdotes of their rapacity and catholic appetites. Tenacity of life is theirs to a high degree, as witness the Blue shark which was caught, gutted, and returned to the sea, only to be recaptured on a hook baited with its own intestines; while the Great White shark that turned King's evidence, yielding on capture the incriminating log-book of an American privateer, may perhaps be awarded the palm for unwitting loyalty to Britannia.

All the great fishes and some of the small ones are described, and some of the largest recorded catches are mentioned, together with much other piscatorial anecdote. Flying fishes have been wisely included, since they are so often seen by travellers; the gliding nature of their flight is emphasized. A simple key to the large fish concludes this section.

Both sections of the book are profusely illustrated with drawings, and there are eight coloured plates of great beauty. Lieut.-Colonel Tenison's scrupulous illustrations greatly enhance the value of the book, particularly for non-scientific readers, who by referring to them should be able to identify both fish and whale easily.

Fraser's contribution on whales and porpoises is of the same high standard, and similarly enriched by narrative. Every whale that the traveller is likely to see is fully described and depicted. There is also a key to this section. A concise history is given of the exploitation of the remunerative species of whales. This story of virtual extermination of one species after another makes sorry reading, but it is particularly apposite at the present time, when the rorqual fisheries of the Antarctic are invaded yearly by huge fleets of highly equipped whale catchers. The author has omitted to point out that there are clear indications that the stock of Blue whales is already greatly diminished. With the decline of Blue whales, the burden of slaughter is falling more and more on Fin whales, of which 12,500 were killed in 1935–36. When the latter also shall have become too scarce to be profitably hunted, the last chapter will have been written in a history of brutal and wanton

exploitation. Other breeds of whales have not in the past had the advantage of scientific investigation; with the statistics which are now available, whalers cannot plead ignorance as they kill the goose that lays the golden egg.

The book is well printed on good paper. The beginning and end of most chapters are embellished with witty line-drawings. Here is an unusual blend of liveliness and scientific accuracy, which should find a place in ships' libraries and on the shelves of all interested in the creatures of the deep.

A. H. L.

A Catechism of Evolution

Evolution and its Modern Critics

By Dr. A. Morley Davies. Pp. xii + 277. (London: Thomas Murby and Co., 1937.) 7*s*. 6*d*. net.

BY evolution we understand that integration and combination of originally homogeneous atoms which has produced our world and its contents. These are governed mainly by physical forces, which are as yet little understood but which represent the governance of the universe. There may in our minds be other thoughts, even certainties, with which we have no quarrel; but these should scarcely be allowed to affect the consideration as to the combinations by which life was originally produced and as to how that life was moulded to give the varied series of organisms we find to-day. It is infinitely more difficult to imagine the production of living matter with its functional reactions to the world around it, than to consider if it evolved afterwards, and the driving forces which caused this evolution. Conversely, if evolution to produce the present organic world be proved, utilizing only natural forces, there is a strong presumption that such forces gave rise to life.

It is with thoughts such as these, here imagined for Dr. Morley Davies, that a start is made on an attempt to prove the adequacy of the evolution theory to explain the diversities of the organic world. In this there is never dullness, for there is originality in both treatment and thought. A good instance is in the chapter devoted to the palæontological record, wherein is patiently explained the exact position in respect to the remains of the organisms of past ages, the impossibility that they shall at present provide any record approaching that completeness for which the student so frequently inquires. Instead of a hypothetical discussion, the author takes Mr. Douglas Dewar's 'Difficulties of the Evolution Theory" in place of a young student's questions, this reinforced by the late G. K. Chesterton's journalism. The student proceeds on his appointed courses from the simple to the complex, but Mr. Dewar apparently has reversed, birds having been his love. We wonder whether he understands the basal phenomena of living matter and the essential functioning of every part of an animal's body with its environment. Quotations from his book in Dr. Davies's chapter on "Reptiles and Birds" suggest this question and he certainly does not understand an animal's fate after death, almost a miracle if its body does not provide nutriment on which the next generation grows. In this connexion a search in the writer's garden produced several hundred clay pipes, but associated with them no recognizable bones other than those of the ox—this he can readily understand, for his dogs allow no other mammalian remains to be recognizable for long. Then too these varied quotations suggest to us that Mr. Dewar considers evolution to have been an infinitely slow process, whereas modern research, especially cytological, suggests a speed in changes which would only by rare accident allow of the preservation of intermediate stages in fossil form. Dr. Davies can scarcely allow Mr. Dewar's idea "of evolution within the family but not beyond it", since there is no understanding among systematists as to the practical definition of "family"; the unit in evolution is the individual, and, if it can change, the question of genera, families and even phyla scarcely needs discussion.

We are always interested in W. R. Thompson's thoughts here quoted; to us he seems to be rather unnecessarily dragged in here. It is otherwise with Sir Ambrose Fleming, of high distinction in the domain of electrical engineering, who in what is in many ways a mischievous lecture dealt with a subject with which he was unfamiliar. He wrote of "Darwinian evolution" requiring a high birth-rate and a low death-rate whereas it requires "a high but selective death-rate". Then there followed Sir Ambrose's attack on the validity of palæontological evidence in respect to man, for which little is claimed—pathetic because there is so little understanding as to what is evidence in scientific and in historical research. The reply here is adequate—and we recommend this little book as likely to be useful to the public as well as to professional teachers and students of science.

J. S. G.

Rock Magmas and their Products

Das Magma und seine Produkte: unter besonderer Berücksichtigung des Einflusses der leichtflüchtigen Bestandteile. Zugleich zweite Auflage des Buches "Die leichtflüchtigen Bestandteile im Magma". Teil 1: Physikalisch-chemische Grundlagen. Von Prof. Paul Niggli. Pp. xi + 379. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 34 gold marks.

THE solid igneous rocks are the products of colossal natural processes working unceasingly within and upon the crust of the earth. The study of these phenomena forms the special province of the petrologist, who attempts to discover the manner in which an original silicate melt—the magma—becomes differentiated into the varied mineral assemblages he finds in Nature.

For more than thirty years the chief project of research of the workers of the Geophysical Laboratory of the Carnegie Institution at Washington has been the experimental investigation on quantitative lines of chemical systems embracing the common rock-forming oxides. Starting with the simplest combinations and proceeding to more complex systems, these investigators have gradually accumulated a wealth of data of fundamental importance to petrology. To this project Prof. Niggli has himself given experimental support, and he is well qualified to survey the experimental studies and the contribution they make to the problems of petrogenesis.

The present book, forming Part 1 of a two-volume treatise on rock magmas and their products, concerns itself with the physical chemistry of heterogeneous and homogeneous systems with special reference to experimental silicate melts. The succeeding volume will be devoted to a consideration of the phenomena of natural systems—magmatic melts and their solidified products, the igneous rocks and ore deposits.

The book opens with a historical account of the development of ideas on the role of volatile substances in the magma. There follow chapters of pure physical chemistry presenting a systematic account of phase equilibria in condensed heterogeneous systems, special attention being paid to the phenomena of petrological significance displayed by ternary silicate melts. The majority of such experimentally investigated systems is included in this survey, which gives a clear account of the alternative courses of crystallization permitted by continuous and discontinuous reactions which may prevail in ternary silicate solutions.

Some criticism may here be made of the method of presentation adopted for ternary melts. In order to trace readily the changing composition of a residual liquid in terms of a specialized variation diagram, and presumably in preparation for more extended discussion in volume 2, the author redraws the ternary figures on a molecular per cent basis. These transformations involve considerable complication when the fundamental phases are themselves complex silicate compounds. It may well be doubted whether so cumbersome an innovation will make appeal to petrologists who have still to discover the superior convenience of the 'Niggli type' of variation diagram for which this procedure is more peculiarly fitted.

In the second half of the book, Prof. Niggli enters upon a discussion of heterogeneous equilibrium in systems containing volatile phases—a subject to which the author has himself made important original contributions. The treatment follows closely the text of his earlier published work—of which this part may be considered a revision.

Equilibria in binary and ternary mixtures involving retrograde boiling and critical phenomena in saturated solutions are thoroughly discussed. Since the experimental data on ternary silicate systems involving water comprise only those of the complex H_2O—K_2SiO_3—SiO_2, the importance of critical phenomena in magmatic systems has yet to be assessed. While the critical state is assigned a more important place in the history of the cooling magma than is usually conceded, the author's renewed discussion of volatile systems is a welcome contribution serving to remove from the field of contention misunderstandings which have followed the publication of his earlier work.

This account is followed by a chapter on homogeneous equilibria in silicate melts. This is a subject of great importance, but unfortunately our knowledge of it is meagre and largely confined to deductions that may be drawn from the behaviour of heterogeneous systems. Here the author rightly lays emphasis more especially on the influence of volatile constituents in modifying the chemical as well as the physical condition of the magmatic melt.

The book closes with an ingenious portrayal in ternary diagrams—admittedly schematic and immensely simplified—of the differentiation course of a typical Atlantic and Pacific rock province. Presented here without elaboration, it is presumably a signal of a more detailed treatment in the concluding volume. Comment upon it may well be deferred. The high reputation of the author is a guarantee that a stimulating and fruitful discussion of these problems is to follow.

C. E. TILLEY.

Overseas Plant Products
By J. H. Holland. Pp. vii+279. (London: John Bale, Sons and Curnow, Ltd., 1937.) 6*s*. net.

THE author has very ably dealt in 268 pages with nearly all the important plant products of the world. Short explanatory notes to each of the products mentioned are authentic, accurate and up to date. Eleven pages of bibliography at the end of the book is a valuable addition. Those interested in further information on any one of the products discussed in the book can consult the particular literature relating to that product. Common vernacular names used generally in different countries might have been added for the advantage of local dealers in plant products. Short notes on the marketing of those products would also have been encouraging to the producers. With the progress of research on various plant products, and the discovery of the uses of many hitherto unknown plants in different countries, particularly in India, Burma and Africa, the list of plant products is growing so rapidly that it is to be hoped a second edition will be quickly necessary; slight discrepancies in some places might then be rectified also.

The book is a valuable addition to the publications on economic botany. It will undoubtedly prove useful not only to those who deal in plant products, but also to anyone interested in the relation of plants to human needs. It will be indispensable to museum workers, economic botanists and pharmacologists. The book is well printed and bound.

Materialprüfung mit Röntgenstrahlen:
unter besonderer Berücksichtigung der Röntgenmetallkunde. Von Prof. Dr. Richard Glocker. Zweite umgearbeitete Auflage. Pp. v+386. (Berlin: Julius Springer, 1936.) 33 gold marks.

SINCE the appearance of the first edition of this well-known work in 1927, the use of X-rays in the examination of materials has been greatly extended. The new edition is similar to the old in general arrangement, and any considerable increase in size has been avoided by careful revision of each section. The description of X-ray outfits (of German manufacture), now includes a full account of portable apparatus for the detection of flaws in built-up structures as well as the laboratory types, and the methods used in the examination of castings, forgings and welds are described. The discussion of determination of crystal structures, which occupies the greater part of the book, is both clear and informative. Tables of important structures are given, including a survey of the principal alloy systems, and such subjects as deformation textures and the determination of internal stress are treated in detail, although British work in this field has been overlooked. The section on transformations in the solid state also suffers through being too closely confined to German investigations, but the general presentation is fair, and the book can be recommended as a sound guide to a very important method of experiment. The mathematical treatment is simple and straightforward, and references to the more important papers under each head are collected in the bibliography.

Quantitative Analysis:
a Theoretical Approach. By Prof. William Rieman, III., and Dr. Jacob D. Neuss. (International Chemical Series.) Pp. ix+425. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 18*s*.

THIS is a most satisfactory text-book for the student. It is up to date, the theoretical principles underlying the various methods are clearly and accurately stated and the conditions for carrying out individual exercises are given in ample detail. To each chapter there is a useful résumé in the form of graded problems, and answers are provided to the numerical ones.

To deal with the theory and technique of potentiometric methods immediately following the volumetric determination of the chlorine ion and before discussing the methods of acidimetry and alkalimetry will be novel to many teachers. Its treatment could scarcely be better, although the authors have to assume a knowledge of mathematics unfortunately not possessed by all students who can profitably work through such a book as this.

No modern method of volumetric or gravimetric analysis with which the student might be expected to be familiar seems to have been omitted. Apart from anything else, the references to original and text-book literature will indicate to the student that quantitative chemical analysis is an important and continually expanding branch of chemical science.

C. S. G.

The Social Thought of the Ancient Civilizations
By Prof. Joyce O. Hertzler. (McGraw-Hill Publications in Sociology.) Pp. xvi+409. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 24*s*.

NO one would dispute the desirability of the possibility of an examination of the social thought of the ancient civilizations, especially after reading the very able book of Prof. Hertzler. It is not only history, but also sociology and philosophy which can benefit from such an examination. For social forms of civilizations are necessarily an embodiment of the thought and attitude towards life of the various races concerned. The systematic exposition of the social thought of the ancient Egyptians, then of the Babylonians with special emphasis upon the Assyrian and Hittite collections of laws, then of ancient Persia, of early India and of ancient China, and finally of the Hebrews, is illustrated with a wealth of quotations from all available sources. The discussion of the principles involved is based also on the general background of the races concerned. The author has taken great trouble in selecting his material and in classifying it in such a way as to provide an intelligible and interesting study of the subject.

G. T.

Wireless Servicing Manual
By W. T. Cocking. Third (revised) edition. Pp. x+241. (London: Iliffe and Sons, Ltd., n.d.) 5*s*. net.

A VERY useful and reasonably priced monograph on the pathology of the wireless receiver, which can be recommended as supplementary reading to the usual text-books.

A Century of Geological Investigation

A CONNECTED history of the work of the Geological Survey of Great Britain has long been overdue. It is true that many details can be gathered from the lives of Edward Forbes, Murchison and Ramsay, from Geikie's "Long Life's Work", and from the registers of the Royal School of Mines and the Royal College of Science. But what was wanted was an impersonal account of the service and its work, written from the point of view of the service itself; and that has now been furnished by Sir John Flett in "The First Hundred Years of the Geological Survey of Great Britain"*. It was the last act of his thirty-five years' service, during fifteen of which he was director, and for another ten assistant to the director for Scotland. It marks the centenary in 1935 of the Survey, and the opening of the new Geological Museum at Kensington by H.R.H. the Duke of York, now His Majesty King George VI.

The author has succeeded in making a clear statement of the complicated history of the Survey itself, and the other institutions now or formerly a part of it or very closely associated with it. He directs attention to the demand for such an institution on the part of the mineral industries of the country and the influence of famous geologists and of the Geological Society, which caused the idea of a State survey to be accepted and even welcomed by the authorities of the time. He has indicated in due proportion the share in the mapping and description of the country taken by the leading geologists of the Surveys. And he has enabled the reader to form a fair judgment on the progress effected as a result of royal commissions and committees of inquiry, and by the successive directors in the favourable or unfavourable conditions prevailing during their periods of office.

It is impossible to speak too highly of the work and influence of the first director-general, Sir Henry De la Beche, appointed in 1835, after he had offered, at trifling cost, to "affix geological colours" to the new maps of Devon and Cornwall about to be issued by the Ordnance Survey. He set himself to do four things which he considered to be essential at the time, and which he saw could be carried out, at first at any rate, by a State Survey as he conceived it: (1) The mapping and description of the geology of the country, especially in relation to its mineral resources; (2) the collection and preservation in some accessible place of the evidence on which such work is founded, the records of the work as it advanced, the literature necessary for proper working up of the material, and specimens to illustrate the geology and mineral resources; (3) the education and training of men capable of doing the work or of directing the development of the mining industries; (4) the collection and preservation of mining statistics and records, especially so far as they are necessary to guide future exploitation. The first two objects have remained and grown as the special care of the Survey; the other two sooner or later budded off and are now living separate and vigorous lives of their own.

It being essential first to acquire an exact knowledge of the ground-work, the geological nature and structure of the land, attention was concentrated on mapping, with a remarkable team which grew steadily in strength. The director himself and his assistants, among whom Aveline, Ramsay, Jukes, Logan and Selwyn were leaders, worked at high speed and with an accuracy which is wonderful when it is considered that only one-inch maps, uncontoured and often unsatisfactory in topography, were all that were available for either field-work or publication. Maps were supplemented by 'horizontal' sections (illustrated by explanations) along specially surveyed routes, and by 'vertical' sections on a large scale giving full detail of thoroughly explored ground. More maps and sections were published under this régime than at any later time. Little leisure, however, was left for writing, and few memoirs were published, those put out being mainly essays on scientific subjects, or descriptions of considerable regions, such as the South Staffordshire coalfield by Jukes.

A museum was opened at Craig's Court in 1841, but ten years later the Prince Consort opened its successor, the Museum of Practical Geology at Jermyn Street, where the collections and workers were housed for eighty years. This "was the first important building in Great Britain designed to be occupied by the staff of a purely scientific institution". The Museum was intended to be definitely national, economic and practical, and in time these objects came to overshadow the scientific side, for example, in the large and valuable collections of metal work and pottery. For these, new and more appropriate sites were found soon after 1901, and room was thus provided for the more direct applications of geology. A distinguished staff was employed in the Museum

* The First Hundred Years of the Geological Survey of Great Britain. By Sir John Smith Flett. Pp. 280+13 plates. (London: H.M. Stationery Office, 1937.) 7*s.* 6*d.* net.

and in expert work in connexion with the mapping. It included such men as Hooker, Forbes, Phillips and Playfair (afterwards Lord Playfair), Percy, Hunt, Warington Smyth and Huxley.

Several of the staff were employed as professors in the School of Mines, which had its home also at Jermyn Street. In spite of this work and their routine duties for the Survey and Museum, time was found for the issue of works on fossils (Decades and Monographs), of memoirs on the economic or other geology of districts, and for the delivery of technical lectures and of more popular lectures for working men. The desire of the Prince Consort, who had given whole-hearted support to the plans, to see the School of Mines grow into a more comprehensive scheme for scientific and technical education was thought premature by De la Beche and his successors, and was indeed not fully brought about until 1910, when the Royal School of Mines, the Royal College of Science and the City and Guilds Engineering College were incorporated as the Imperial College of Science and Technology. The School of Mines was, however, largely by Huxley's influence, removed to South Kensington between 1872 and 1883, and many of the books were taken from the library to form the basis of the Science Library there.

Sir Roderic Murchison, as director-general, brought to the institution from outside great organizing ability and valuable social influence. His work (1855–71) was mainly comprised within the framework of his predecessor's scheme, but he strengthened the administration and inspection, and brought about a much-needed increase in staff. All De la Beche's plans of publication were continued, but there was inaugurated the issue of memoirs on individual map sheets, and on several coalfields on which the mapping was being concentrated, while museum handbooks and district memoirs were added to those already published, including Ramsay's great memoir on North Wales. The first index map, of Wales and its borders, on the quarter-inch scale, was also published.

The appointment of Sir Andrew Ramsay as director-general in 1871 illustrates one of the difficulties that have been inherent in the Survey. The duties of inspection, reporting and administration are so heavy that a director must practically abandon all his own field-work, and thus the field staff loses both an inspiration and a standard. Ramsay was certainly one of the finest field-men who ever lived and his loss was most serious in this capacity. Fortunately it proved that his organizing powers were also considerable, but the work speedily wore him out. Under his direction, the first 'drift' maps were prepared, new museum catalogues and handbooks were issued, very valuable collections were acquired by the Museum, such as the Ludlam collection of 20,000 minerals, and some of the most important memoirs ever written were published, among them that on the Yorkshire coalfield, and those on London, Rutland, and the Weald. The Survey being, up to this date at least, the principal training ground for professional geologists, had to face the inevitable loss of some of its best men to fill teaching posts in universities and colleges and to assume the direction of other surveys.

Sir Archibald Geikie, who had been a member of the Survey for twenty-six years, a great part of that time in sole charge in Scotland as well as professor at Edinburgh, was appointed director-general in 1882, and served in that capacity for twenty years. In accordance with his undertaking, the 'solid' map of England was finished by 1884, and that of Ireland four years after. A 'drift' survey, of as great value to the agriculturist as the 'solid' maps are to the miner, now chiefly claimed attention, and as maps were revised for this purpose they were also brought up to date on the 'solid' side. This entailed the publication of a large number of maps, many of which were now accompanied by sheet memoirs. Some district memoirs, a few on coalfields, the first one on water-resources, and the first complete index map on England and Wales, were also published. But the chief departure, one abandoned by his successors, was the issue of memoirs devoted to individual formations—Jurassic, Cretaceous, etc. Petrology was now put on a level with palæontology, and specialists were appointed. Teall was brought in to deal with Scottish, and particularly Highland, rocks, and Harker to map and describe the Tertiary igneous complex of Skye. Much was done to exhibit Survey material worthily in museums at Edinburgh and Dublin, and the customary "Annual Report" was converted into a "Summary of Progress", containing some account of the chief discoveries made during the year This "Summary" has now also become a magazine for communications by the staff. A start was made with the much-needed revision of the coalfields, among others that of South Wales, which was put in charge of Strahan. It expresses the state to which grading and organization in the service had sunk when it is realized that the officer chosen for this highly responsible task was still an 'assistant-geologist' after sixteen years' service, and that he had under him men who had been full 'geologists' for more than twenty years.

The very considerable improvements in organization recommended by the Wharton Committee of 1900 took effect in the appointment in 1901 of Sir Jethro Teall as director, and a new grading and enlargement of the staff. This inaugurated a period of renewed activity. Much coalfield

revision, recommended by the Coal Resources Commission, was carried out in England and Scotland, and many coalfield, coal-chemistry, oil-shale, water and sheet memoirs were published. Field-work was now all executed on the six-inch scale, and the revision published on the 'New Series' ordnance maps. Colour printing replaced the old hand colouring on all one-inch maps, the quarter-inch index, and the new small-scale map of the entire kingdom. Thus maps were cheapened and made available to a much larger public, and it became possible to supply them in quantity at a reduced price for educational purposes. Vertical and horizontal sections were also printed on the map margins. The publication of palæontological monographs was resumed, and the district memoirs included the great works on Skye, the Highlands and Lowlands of Scotland, and the Isle of Man. Much use was made of photography for illustration as well as in the Museum, and the removal of extraneous collections and of the lecture hall gave fresh space for developing the modified purposes of the building. The Survey of Ireland was separated in 1908, after a series of new drift maps had been published under Lamplugh's direction.

The directorship of Sir Aubrey Strahan (1914–20) was crippled by the Great War, the staff being largely called on for service. What remained of them brought out the publications that were on the stocks and then, with some voluntary help, devoted themselves to writing a new series of memoirs dealing with the mineral resources of the country, many of them seriously needed to replace supplies from abroad now cut off. Water problems and other geological ones at the seats of war were met by members of staff in the army or at home, and special search was made for sources of such things as sand, quartz, oil, refractories, fluorite, sapphire, etc., needed for munitions. At the end of the War, the Survey was taken over from the Board of Education by the new Department of Scientific and Industrial Research ; and a Geological Survey Board was formed to assume the duties formerly discharged by a Committee of Advice.

Sir John Flett does not give very full details in his book of the progress under his own directorship, but much can be gleaned of efficiency and progress from what is stated. The staff was enlarged, publication of sheet memoirs and maps was pushed on more actively than even before, the resources memoirs were brought up to more than thirty, coalfield and water memoirs continued to appear, monographs and vertical sections were resumed, and experiments were made on the applications of geophysical apparatus. Uncoloured six-inch maps with geological lines prepared from the field sheets were rendered available. Co-operation was given to Boards of Fuel and Building Research, to the Inland Water Survey, to the search for oil, and to the making of soil-maps. New rights to information revealed by shafts and borings were acquired, the careful collection of kindred information, often confidential, was continued, and the relations of mutual respect and confidence with the managers of mining and other industrial operations were strengthened. A successful experiment on decentralization was tried, and four centres in the north of England were established. The publication of the last of the great series of memoirs on the Scottish Tertiary volcanic centres contributed what is perhaps the most important addition ever made to knowledge of active as well as extinct volcanoes ; and memoirs on concealed coalfields give leading to fresh industrial development.

Meanwhile, probably as a result of the explosion of an aerial bomb in Piccadilly, the Museum had fallen into irreparable disrepair, and much of it had to be closed. When it was clear that repair was out of the question, the Survey Board, and especially its chairman, Sir Francis Ogilvie, seconded by the Museums Commissions, pressed on the Government the need for a new museum. Eventually a site was found and a new building erected, the site of the old one proving so valuable that it may be even said the change was an actual source of profit, a last legacy of the far-seeing De la Beche. The director and his staff carefully planned the utilization of the increased space provided, removed and replaced all the collected material, and devised methods of storage, illustration and display which have given fresh uses and great popularity to the new Museum.

An account is given at the end of the book of the opening of the new Museum and the celebration of the Survey centenary, which were attended by a large concourse of Government and scientific delegates, who came from all parts of the country and all over the world to bring their congratulations and commendation. A group photograph of the delegates and a full list of them are given in an appendix. Other appendixes give a bibliography and a carefully prepared list of nearly three hundred Survey officers who could be traced, with brief notes on their service and career. This list contains the names of four presidents of the Royal Society.

Thus the Survey makes an auspicious and hopeful beginning of its new century, and the author of this work and his colleagues, past and present, are to be congratulated on such a worthy record of a hundred years of sound and faithful work, a justification of the hopes and ambition of its originator, and a valuable asset to the industrial life of the nation.

W. W. WATTS.

Pasture Problems

THE many problems connected with cultivated grassland have recently received considerable emphasis. The International Grassland Congress, meeting at Aberystwyth in July, brought together some four hundred delegates, and further discussion of the subject took place during the Nottingham meeting of the British Association at a joint symposium of Sections K (Botany) and M (Agriculture). An outline of the range of problems there discussed may prove of some general interest.

Grassland problems are largely determined by the perennial nature of the crop, which is a mixture of several species that are in constant competition with one another. These species settle down to a certain equilibrium among themselves, but this is easily upset by changes in the environmental conditions. Rainfall, temperature, sunshine and drought all play their part in encouraging some species at the expense of others, so causing either temporary or permanent changes in the balance of composition of the herbage. The quality and type of herbage are also very dependent upon the general management of manuring and grazing. Uncultivated grassland tends to become very rough and often develops a layer of peat on the surface, but with correct grazing a more even sward is obtained and the more valuable species are encouraged. Land that is always cut for hay bears a different flora from that which is grazed, owing to the variation in the response of species and the two methods of treatment. The time of seeding is also an important factor, and helps to determine the question of survival under cultivation. Wild white clover is a most valuable feeding plant, and is encouraged where land is properly grazed so that competition for light and air is reduced to a minimum.

Of recent years, the work of the Welsh Plant Breeding Station at Aberystwyth has shown the importance of selecting the varieties and strains of grasses that are appropriate for the particular purpose for which they are required. Pasture types and hay types of the same species are radically different in their habits, and success or failure in establishing new areas of grassland largely depends upon the selection of the seeds sown.

In sowing down new pastures, the type of mixture to be used presents its own problems. Complex mixtures of many species and simple mixtures of few species each have their advocates, and no definite ruling can be made as to which is preferable. Much depends upon environment and upon the object that it is desired to attain. Experiments and analyses carried on at Rothamsted for ten years, on land sown with a variety of seeds mixtures, have shown that the ultimate composition of the sward is very similar, regardless of the simplicity or complexity of the mixture initially sown. Some species are short lived, and though they may prove useful in providing grazing for the first year or two, they soon disappear, and their place is taken either by some other constituent of the original seeds mixture or by interloping species which establish themselves naturally. The balance existing between the groups consisting of grasses, leguminous and miscellaneous species may be entirely upset by prolonged drought, which in some cases may kill out the wild white clover, leaving bare spaces which are often invaded later by grass.

In addition to climatic variations, the grazing animal plays a most important part in the development of a sward. The various types of plants in a pasture are all in keen competition, and any factor which weakens one species gives the others a better chance. The grazing animal naturally eats down the most palatable species first, leaving the inferior plants alone except in times of scarcity. The lack of palatability of the latter plants thus affords them protection from grazing and so enables them to increase unduly. Very careful manipulation of the grazing is necessary to prevent this undesirable change in the balance of the species, and controlled grazing periods, together with artificial feeding of the animals at certain critical periods of the year, are necessary to keep the herbage at its best.

During the discussion at Nottingham, special emphasis was laid on the interdependence of the various principles of grassland management. Improvement may be considered from the point of view of the botanical composition of the herbage, pasture and stock management and soil fertility, but whatever is done in one direction is reflected in the reaction of the grassland as a whole. Methods of improvement and management vary in temporary and permanent pastures, and the botanical composition and the yield respond to the contrasting systems of management.

An outstanding problem is the difficulty of getting an accurate measurement of the value of grassland from the point of view of its productivity and feeding capacity. Empirical observations of

the herbage and the stock afford a useful guide to the skilled farmer, but more accurate and quantitative information is necessary for the true comparison of different systems of management. The accurate assessment of yield presents many difficulties, as estimates obtained by continuous cutting to simulate grazing are misleading, since the period and intensity of actual grazing have very far-reaching effects on the sward. In order, therefore, to simulate grazing conditions as closely as possible, experiments of somewhat complex design are necessary, in which there is sufficient replication to permit grazing over the greater part of the experimental period, with infrequent cuts for the actual determination of yield. The type of stock used and variation in seasonal conditions also play their part in complicating the problem.

In the open discussion at the end of the symposium, the question was raised as to the possibility of laying down some clear directions for the practical man in the management of his sward. From the nature of the case, however, this is an impossibility, as the problems are so complex and the correct methods of management are so diverse. Treatments that are effective in one place, on one type of soil or under certain climatic conditions may be quite unsuccessful elsewhere or in other seasons. Careful observation of the effect of grazing on the sward, together with intelligent use of the results of such observation, are essential for the successful production of first-class pastures providing feed of high nutritive value. Furthermore, recent developments in the improvement of wild hill pastures along economic lines have opened up great possibilities for extended and profitable grazing, provided the active co-operation of the interested farming community is forthcoming.

WINIFRED E. BRENCHLEY.

Zoological Expedition to the Oasis of Siwa, Egyptian Libya

By Joseph Omer-Cooper, Rhodes University College, Grahamstown, South Africa

THE Armstrong College Expedition to Siwa, consisting of Dr. Malcolm Cameron, Mr. C. L. Smith and myself was financed by the Royal Society, the Godman Exploration Fund, the Percy Sladen Trust, the British Museum (Natural History) and the Armstrong College Research Fund. Its object was the study of a typical Libyan oasis. We left England in March and returned in October 1935, after spending six months in the Libyan Desert and achieving all our objectives. Transfer from the staff of the Department of Zoology, Armstrong College, Newcastle-on-Tyne, to Grahamstown, South Africa, has been the principal cause of delay in presenting a preliminary report of the Expedition's results.

Siwa is watered by more than two hundred wells and springs. These in many cases flow into storage reservoirs from which the gardens are irrigated. The irrigation waters ultimately flow into pools or lakes from which there is no outlet. These are saline, and if large are known as 'birkets'. The water of the springs is thermal, the bottom water varying from 25° to 29° C. The salinity, which is slightly more variable, appears to be affected by the proximity of the birkets. In Siwa the larger springs, in which concentration by evaporation was negligible, had a chlorine content of 0·685–1·475 gm. chlorine per litre. The water contains little oxygen. Smith examined water from pipe wells, so obtaining pure samples of the subterranean water, and found only 0·105 c.cm. oxygen per litre. The water is supersaturated with gas which is more than 97 per cent nitrogen; the residue being oxygen, carbon dioxide and inert gases. As the springs in several other Egyptian oases have the same peculiarities, it is probable that the water is derived from one great subterranean source.

The North African subterranean waters contain a considerable fauna, but no subterranean forms have been recorded from Egypt. This curious fact is adequately explained by the small oxygen content. This also explains the absence of the indigenous Siwan Cyprinodont fish from the larger springs, and the failure of Dr. H. Faouzi to introduce *Tilapia* into these springs, which appear excellently suited to them.

In certain springs the Cyprinodonts have the swim bladder much swollen and are unable to submerge. Some fish are almost globular. This is no doubt due to the water being supersaturated with nitrogen.

Siwa was notorious for immense swarms of mosquitos. It was this, in part, which caused us to choose it for investigation. In 1930 Dr. Zoghib started an ingenious and successful anti-mosquito campaign. The indigenous Cyprinodont was present in a few of the springs and streams only, and these were much overgrown with reeds, rushes and other vegetation. Dr. Zoghib had the springs and ditches cleaned, and introduced the fish into those not already containing them. Fortunately for us, during his one year of duty at Siwa, he was unable to deal with all the springs, and by the time we arrived many of these had been long neglected, so that we were able to study the primitive conditions. While we were there, Dr. Zoghib was again sent to Siwa as medical officer and continued his work. In this he was aided by the successful introduction of *Tilapia* by Dr. Faouzi. Before we left, the mosquito breeding places had been almost eliminated.

The introduction of *Tilapia* by Dr. Faouzi in 1932 has already had an effect. In certain slow-flowing springs, they have multiplied greatly. The change produced is the most striking ecological effect, produced by a single organism, which I have seen. The plants have disappeared and with them the Cyprinodonts, Mollusca and insects; even the Crustacea have been almost eliminated; *Cladocera* are absent and Copepods and Ostracods are scarce. The water, clear in similar springs in which *Tilapia* are absent, is cloudy and contains numerous flagellates, Protozoa and rotifers. The fish feed on the mud. Within a few years it is probable that they will have exterminated the greater part of the aquatic fauna.

Most of the birkets are very saline, and at the most contain a few *Artemia*. At Baharein in the East Lake, there were numbers of minute Hydrophilid beetles but nothing else. The water was cloudy, unpleasant smelling, and had a specific gravity at 60° F. of 1·1498. It is possible that the beetles lived on drowned insects. In an inlet fresh water flowed over the salt water and contained fish. Smith found that the surface temperature was 27·2° C., but it rose rapidly and towards the bottom reached 52·9° C. His observations here and at Siwa show that this temperature gradient was due to solar radiation in the absence of convection currents. At Sitra, springs rose in the lake and the fresh-water spread for some distance over the surface. In these springs were fish which appeared to feed on the *Artemia* living in the saline water. The Birket El Gessabaia had a specific gravity at 60° F. of only 1·0357 and contained a number of marine organisms including diatoms, algæ, *Cardium edule var.*, *Mytilus minimus*, *Pirenella conica* and *Balanus sp.* The *Cardium* and *Balanus* were recent but we found no living specimens, although we obtained living *Mytilus* and *Pirenella*. This fauna is similar to that of the Birket Qarun, and may have been introduced by birds.

In searching our material from El Gessabaia and some other localities for algæ, Dr. Kathleen Blackburn discovered Foraminifera. These were sent to Mr. Heron Allen, who reported that *Trochammina*, *Miliolina*, *Reophax*, *Discorbina* and *Gromia* were present. Some of the species he believes to be identical with those described by L. Gauthier Lièvre from the lakes of the Oued Rhin. None of the species are common Mediterranean forms. This fact, coupled with their occurrence in such widely separated localities, suggests that they may have had a different origin from the recent marine immigrants of El Gessabaia. It is possible that they are very ancient relicts.

It is very generally believed that much of the desert fauna æstivates. My experience of the Somali desert made me sceptical of this and, despite much adverse criticism, we made the summer our chief collecting time. In this we were justified, for, contrary to the general belief, insects proved most numerous in July and August. During the heat of the day there was a striking absence of insects in the open desert, although Hymenoptera were numerous in the oasis. In the evenings and at night, however, insects and arachnids abounded. It is this, no doubt, which has given rise to the popular belief that the fauna æstivates.

One of the objects of the Expedition was to find out whether Siwa is a nodal point in the bird migration. Our observations were sufficient to convince me that it is not. The birds cross the desert on a wide front. The concentration which occurs in the oases is due to the infiltration of stragglers, marooned in the desert.

The insect fauna appeared to be Ethiopic rather than Mediterranean; although, as was to be expected, a considerable proportion consisted of widely distributed forms. The dominant groups were Odonata, Orthoptera, Neuroptera and Hymenoptera: Lepidoptera were also abundant, but Coleoptera and Diptera were scarce. Ancient forms appeared to predominate in the desert regions: *Thysanura*, for example, were numerous. The shifting sands of the desert, like those of the sea, appear to form a refuge for archaic forms of life.

Towards the end of our stay at Siwa, we rarely obtained species not previously captured. This gives us reason to hope that our material is adequate to give a true picture of the ecology of Siwa, and that when the collections have been worked out our results will be reasonably complete.

The British Association and the Indian Science Congress

THE majority of the members of the British scientific delegation to the jubilee meeting of the Indian Science Congress Association (see NATURE, Oct. 9, p. 609) left Tilbury on November 26, on the P. and O. liner *Cathay* for Bombay. Some of the party will join the ship at Marseilles, leaving London overland on Thursday, December 2. The British delegation will include representatives of every major department of science; and several distinguished foreign and other representatives have been invited directly by the Indian Science Congress Association; the party will number in all more than a hundred.

The great majority will make a tour through northern India before the Congress in Calcutta, after an official reception in Bombay (December 16–18), and a visit to Hyderabad, where they will be the guests of the Nizam's Government (December 19–21). Agra will be reached on December 22, and Christmas Eve and Christmas Day will be spent in Delhi. At Dehra Dun (December 26) the Forest Research Institute and the Geodetic Branch of the Survey of India will be visited, and there may be an occasion for a run to Mussoorie for the view of the Siwalik Hills and the outer Himalayas. Benares will be visited on December 27–28, and between this and Calcutta a geological party will diverge southward from the railway. Calcutta will be reached on December 29, and as the Congress will not begin until January 3, it is expected that a number of members will occupy intervening days with excursions to Darjeeling or elsewhere.

It is understood that H.E. the Viceroy will open the Congress, and that Sir James Jeans, as president, will give a brief address and will then communicate to the meeting the presidential address prepared by the late Lord Rutherford, who was to have occupied the president's chair.

The sectional presidents of the Congress are:

(1) Mathematics and Physics, Dr. C. W. B. Normand, director-general of observatories, Meteorological Office, Poona 5.

(2) Chemistry, Prof. S. S. Bhatnagar, director, University Chemical Laboratories, Lahore.

(3) Geology, Mr. D. N. Wadia, officiating superintending geologist, Geological Survey of India, 27 Chowringhee, Calcutta.

(4) Geography and Geodesy, Dr. A. M. Heron, director, Geological Survey of India.

(5) Botany, Prof. B. Sahni, professor of botany, University of Lucknow.

(6) Zoology, Prof. G. Matthai, professor of zoology, Government College, Lahore.

(7) Entomology, Mr. M. Afzal Husain, principal of the Punjab Agricultural College, Lyallpur, Punjab.

(8) Anthropology, Dr. B. S. Guha, Zoological Survey of India, Indian Museum, Calcutta.

(9) Agriculture, Rao Bahadur T. S. Venkatraman, Imperial sugar-cane expert, Lawley Road, Coimbatore.

(10) Medical Research, Sir Upendranath Brahmachari, professor of tropical medicine, Carmichael Medical College, Calcutta.

(11) Veterinary Research, Sir Arthur Olver, animal husbandry expert, Imperial Council of Agricultural Research, New Delhi.

(12) Physiology, Brevet-Colonel R. N. Chopra, officiating director and professor of pharmacology, School of Tropical Medicine, Calcutta.

(13) Psychology, Dr. G. Bose, University College of Science, Calcutta.

The Congress will run from January 3 until January 9, with an intervening day (January 6) for short excursions. Afterwards some fifty of the B.A. party will visit Madras, Bangalore and Mysore, while others will pay individual visits to other places in connexion with their special scientific interests. A large proportion will leave Bombay homeward bound by the S.S. *Strathaird* on January 15. Among the party are:

Dr. F. W. Aston.	Sir Arthur Hill.
Prof. F. G. Baily.	Sir Frederick Hobday.
Prof. E. C. C. Baly.	Dr. O. J. R. Howarth.
Prof. E. Barker.	Prof. G. W. O. Howe.
Prof. V. H. Blackman.	Sir James Jeans.
Prof. P. G. H. Boswell.	Prof. J. E. Lennard-Jones.
Prof. A. H. R. Buller.	Dr. Ll. Wynn Jones.
Prof. P. A. Buxton.	Mr. R. H. Kinvig.
Mr. J. M. Calie.	Mr. J. McFarlane.
Prof. G. D. Hale Carpenter.	Dr. C. S. Myers.
Prof. N. M. Comber.	Dr. W. G. Ogg.
Prof. F. A. E. Crew.	Prof. A. G. Ogilvie.
Dr. E. M. Crowther.	Mr. H. J. E. Peake.
Prof. Winifred Cullis.	Dr. E. P. Poulton.
Dr. C. D. Darlington.	Prof. H. H. Read.
Prof. C. G. Darwin.	Dr. A. B. Rendle.
Mr. T. S. Dymond.	Prof. H. R. Robinson.
Sir Arthur Eddington.	Dr. R. N. Salaman.
Prof. C. B. Fawcett.	Lt.-Col. R. B. S. Sewell.
Prof. W. G. Fearnsides.	Prof. J. L. Simonsen.
Sir Lewis Fermor.	Prof. R. V. Southwell.
Prof. R. A. Fisher.	Prof. C. Spearman.
Prof. H. J. Fleure.	Dr. L. Dudley Stamp.
Prof. F. E. Fritsch.	Prof. F. J. M. Stratton.
Prof. R. Ruggles Gates.	Sir Henry Tizard.
Prof. W. T. Gordon.	Dr. A. E. H. Tutton.
Prof. J. W. Heslop Harrison.	Dr. W. W. Vaughan.
Sir James Henderson.	Dr. J. A. Venn.
Prof. J. Hendrick.	Prof. R. G. White.

The following non-British men of science will also be among the visitors:

Prof. L. Diels, Botanical Gardens, Berlin.
Prof. F. von Eickstedt, Anthropological Institute, Breslau.
Prof. C. G. Jung, University of Zurich.
Prof. W. Straub, University of Munich.
Prof. Dr. L. Cipriani, Royal University, Florence.

Obituary Notices

Prof. G. A. Schott, F.R.S.

GEORGE ADOLPHUS SCHOTT was born at Bradford on January 25, 1868. From Bradford Grammar School he went up to Trinity College, Cambridge, in 1886 as a pensioner with an open exhibition in science. He took a first in each part of the Natural Sciences Tripos, and it is interesting to notice, in view of his later career, that his first in the second part of the Tripos was in chemistry. He became a College scholar in 1888 and took his bachelor of arts degree in 1890.

In 1893 Schott was appointed lecturer in physics at the University College of Wales, Aberystwyth. There his interest turned increasingly towards the mathematical side of his subject. During the year 1906–7 he was granted leave of absence to work abroad, chiefly at the University of Bonn, on electromagnetic radiation, the subject which held most of his attention throughout his life. Between 1906 and 1908 he published a series of papers on this subject in the *Philosophical Magazine* and in German periodicals. In 1909 he won the Adam's Prize with an essay based on these papers and entitled "The radiation from electric systems or ions in accelerated motion and the mechanical reactions on their motion which arise from it". His book "Electromagnetic Radiation", published by the Cambridge University Press in 1912, was an extension of this essay, and still remains a standard work on the mathematical aspect of the classical theory.

Schott became lecturer in applied mathematics at Aberystwyth in 1909, and in 1910 was appointed to the chair of applied mathematics there. He was indeed the first holder, and he himself built up the department. Later, in 1923, he became head of both the departments of pure and applied mathematics, and it was only at his own request that the departments were again separated in 1929.

From 1915 or thereabouts until the end of his life, Schott was particularly interested in the new developments of the electromagnetic radiation theory which arose from the relativity and quantum theories. He published a series of papers in the *Proceedings of the Royal Society*, and elsewhere, on topics in this field. He became a doctor of science of the University of London. In 1922 he was elected to fellowship of the Royal Society.

For a considerable period before his retirement, a large part of Schott's time had been devoted to College business. In 1932 he was appointed vice-principal of the College and for a time in 1933, during the illness of the principal, his duties became very heavy indeed. It was typical of him that even during this period of overstrain, the work of his department was not allowed to suffer in the smallest detail.

Dr. Schott retired from the chair of applied mathematics at Aberystwyth in June 1933, but held office as vice-principal until the end of December of that year. While still in his full powers he died very suddenly on July 15, 1937.

As a mathematician, Schott was a master of technique, his interests ranging over almost the whole field of applied mathematics and mathematical physics. His best work was done in connexion with the classical theory of electromagnetic radiation. It is noteworthy that he maintained until the last that the classical theory had yet to be proved inadequate. His most recent work is concerned with the rigorous calculation of the field of a rigidly electrified sphere and the resulting reaction on the sphere. In particular, he proved that such a sphere is capable of moving in radiationless orbits, a very significant result from the point of view of atomic structure.

The keynotes of his personal character were sincerity and scrupulous attention to detail. His academic distinction was carried with a simple kindliness that coloured with affection the deep respect and admiration of his colleagues and students towards him.

WE regret to record the death of Miss B. Pullen-Burry, which took place on September 21 at Hindhead at the age of seventy-nine years. Miss Pullen-Burry, who was born on February 14, 1858, was for many years a familiar figure at anthropological gatherings. She was a staunch believer in the anthropological method of approach in the study of problems of cultural contacts when that point of view had still to win recognition outside certain not very widely extended circles. It was this aspect which she stressed in her communications to the Anthropological Section of the British Association, dealing with the Negro under British rule and in America, and with the natives of New Britain, and afterwards incorporated in her books "Jamaica As It Is" (1903), "Ethiopia in Exile" (1906), and "In a German Colony" (1909). Miss Pullen-Burry travelled extensively in Europe, the Holy Land, Egypt, India, Japan, Australasia, German New Guinea, the West Indies, the United States and Canada. In 1912, she was the first president of the Union of Women of Geographical Interests, an organization which she had a large share in founding.

WE regret to announce the following deaths :

Sir Jagadis Chunder Bose, C.S.I., C.I.E., F.R.S., emeritus professor in the Presidency College, Calcutta, and founder and director of the Bose Research Institute, Calcutta, on November 23, aged seventy-eight years.

Prof. C. Gravier, professor of zoology in the Muséum national d'Histoire naturelle, Paris, on November 14, aged seventy-two years.

Prof. Ludwig Plate, formerly professor of zoology and director of the Phyletic Museum, Jena, aged seventy-five years.

News and Views

Dr. R. R. Marett, F.B.A.

ON November 20, the University of Oxford conferred the honorary degree of D.Litt. upon Dr. Robert Ranulph Marett, rector of Exeter College, Oxford, in recognition of his services to the study of anthropology. Dr. Marett has been closely identified with Oxford for the greater part of his life, first as senior exhibitioner of Balliol College, then as fellow, sub-rector and tutor of Exeter College, of which he became rector in succession to the late Dr. L. R. Farnell in 1928. Dr. Marett has held a distinguished position in academic circles as a philosopher since the days when he crowned his career as an undergraduate by winning the Green Essay Prize in Moral Philosophy, after being awarded the Chancellor's Prize for Latin verse; but to the outside world he is best known as an anthropologist, the formulator of the theory of preanimism in the study of primitive religion, the author of a number of books and contributions to scientific publications dealing with the beliefs and ethics of primitive man, as well as a writer on matters of prehistoric archæology with a knowledge based upon practical experience in cave exploration and excavation.

WITHIN the precincts of the University, however, it is recognized that Dr. Marett's services to the study of anthropology go beyond his personal contributions to research and the advancement of knowledge. He has played the part of pioneer and advocate in organizing facilities within the University for others to pursue these studies. Not only did he take a prominent part in the arrangements for the instruction of officers destined for the Sudan Civil Service, as well as in the institution of a diploma in anthropology, but after the vacation of the professorship of anthropology by the late Sir Edward Tylor, when the chair was virtually in commission, he with the late Prof. Arthur Thomson, the anatomist, and Dr. Henry Balfour of the Pitt-Rivers Museum, were the protagonists in a struggle to secure increased recognition for a subject which had not yet won popularity among academic subjects. It was mainly through Dr. Marett's efforts that the University readership in social anthropology, which he had held for some years, was raised recently to the dignity of a professorial chair.

Dr. R. E. Priestley

THE newly appointed vice-chancellor of the University of Birmingham (see p. 942), Dr. R. E. Priestley, has had a varied career. Born at Tewkesbury and educated at Tewkesbury Grammar School under his father, he proceeded to the University of Bristol. His course there was interrupted when in 1907 he joined Shackleton's expedition to the Antarctic as a geologist and was thus occupied until 1909, when he went to Sydney and resumed his geological studies, working out with Prof. Edgeworth David the results of the Expedition. In 1913 he joined Scott's antarctic expedition and became a member of the Northern Party, a history of which he gave in his book "Antarctic Adventure". Returning to England after the outbreak of the Great War, he joined the army, going to France with the R.E. Signals and attaining the rank of major and being awarded the M.C. Later, at the War Office he wrote the history of the Signal Service in France and a book called "Breaking the Hindenburg Line". He then went to Christ's College, Cambridge, and took the M.A. degree. He was elected a fellow of Clare College, and ultimately became secretary general of the Faculties of the University. In 1935 he was appointed vice-chancellor of the University of Melbourne and while holding that office he visited many universities in Canada, the United States and New Zealand, thus acquiring knowledge of the problems of the English-speaking university world.

Prof. Carl Neuberg

Enzymologia, the new journal edited by Prof. Carl Oppenheimer, devotes its entire third and fourth volumes, 568 pages in all, to commemorate the sixtieth birthday of Carl Neuberg, which took place on July 29, 1937 (Vol. 3. Neuberg-Festschrift, Teil 1. Pp. xiv + 300 + 5 plates. Vol. 4. Neuberg-Festschrift, Teil 2. Pp. viii + 268 + 9 plates. Den Haag: Dr. W. Junk, 1937. 15 florins each). No fewer than 87 papers by nearly twice that number of colleagues are contributed in honour of Neuberg, all dealing with some branch of the ever-widening enzyme question. It may be recorded that in the course of his forty years activity, he and his students have published 1,000 papers, whilst not the least of his services to his chosen science has been his editorship of the *Biochemische Zeitschrift*, which he founded in 1906 and produced 280 volumes by 1936. The numerical introduction we have given indicates a perfect spate of research and publication far too great to be properly assimilated by any one reader, though it is scarcely necessary to emphasize that Neuberg has to his reputation achievements of outstanding quality, notably his work on fermentation. The writer well remembers him working as a student of A. Wohl in Emil Fischer's laboratory in 1900 onwards, when Neuberg was also acting as assistant to Ernst Salkowski in the pathological institute of the University of Berlin, and may be allowed to use this opportunity to offer him also the congratulations of his English colleagues. Neuberg followed Wassermann in 1920 as director of the Kaiser Wilhelm Institute for Biochemistry in Berlin-Dahlem and has carried out all his work there until he retired last year. He made this institute an outstanding centre of research activity and attracted workers of all countries to it.

Edward Divers, F.R.S. (1837-1912)

AMONG the British men of science and engineers who some sixty years ago laid the foundation of scientific instruction in Japan, none was more highly esteemed than Edward Divers. Born in London on November 27, 1837, he attended the City of London School and then studied under Hofmann at the old College of Chemistry, Oxford Street. He graduated M.D. at Queen's College, Galway, and later was lecturer in materia medica at Queen's College, Birmingham, and in medical jurisprudence at Middlesex Hospital Medical School. In 1873, at the invitation of the Public Works Department of Japan, he, with ten other Englishmen, went to that country to establish a College of Engineering. The first principal of the College was Henry Dyer (1848–1918), but on his return home in 1882, Divers was appointed to succeed him. Later, when the College became a part of the Imperial University, Divers became professor of chemistry in the Department of Science. He remained in Japan until 1899, when he was made emeritus professor. After his retirement, Divers settled in London, where his house became the 'Mecca' of Japanese students visiting England. He received honours from the Japanese Government, and a bronze statue of him was erected in the College courtyard. Most of Divers' original papers were contributed to the *Journals* of the Chemical Society and Society of Chemical Industry. Of the former society he became a vice-president and of the latter he served as president in 1905–6. He died on April 8, 1912, and was buried at Brookwood.

Town Life in Early Britain

DR. R. E. MORTIMER WHEELER'S Norman Lockyer Lecture for 1937, which was delivered on November 24, the first occasion on which this lecture of the British Science Guild has been given under the auspices of the British Association, in dealing with the beginnings of town life in Britain in the light of the evidence of recent archæological investigation, was of marked importance for the history of the growth of civilization among the British people. It was at the same time a striking demonstration of the manner in which modern methods of archæological research and interpretation are able to illuminate the dark places of history, and even in some instances modify in no small degree inferences from literary and other sources which have attained the status of dogma. Dr. Wheeler's purpose was to test the statement that town life was non-existent in pre-Roman Britain and to check our estimate of the Roman contribution to the urbanization of Britain. Excavations at Wheathampstead and Verulamium, he pointed out, have filled in details of the picture of the British 'city' in Kent and Hertfordshire as given by Cæsar, to whom they appeared as fortified woodland clearings. The recent excavations have shown that the size, situation, interdependence and cohesion of these settlements lift them out of the parochialism of a mere peasant kraal.

IT is, however, in south-western Britain, on the downlands of Wessex and along the foothills of the Welsh border that, as Dr. Wheeler went on to show, the most obvious and dramatic vestiges of our pre-Roman communities have survived. Sites of the Iron Age between central Hampshire and eastern Devon alone number upwards of seventy. Such fortified settlements, of which the recently excavated Maiden Castle is a conspicuous example, in their size and their domestic and defensive economy imply no small degree of authority and skill. They can only be designated 'towns' or 'cities' in a full sense of the term. In the light of these new facts—or newly verified facts—it is difficult to deprive the Celtic inhabitants of lowland Britain of the rights of citizenship. But there is another side of the picture; and this modification of the traditional view must not be pressed too far. As Dr. Wheeler indicated, one important element of city life is lacking, namely, commerce. The economic basis of these communities was agricultural and their sphere a given limited tract of country. At Maiden Castle, for example, where hundreds of objects have been recovered in four years' excavation, it is surprising to find how few had been brought from far afield. It was made clear in Dr. Wheeler's account of British organization on and after the Roman occupation that it was this lack of appreciation of the commercial element in civic life that caused the Romanization of Britain to make little permanent impression on the life of the people, except in so far as the villa system gave rise to something in the nature of a squirearchy, which was not foreign to native agricultural tradition —a tale not without a moral for our modern administrators of backward peoples.

Roman Pottery from Ewell, Surrey

IT is to be inferred from the number of antiquities of the Roman period which have been discovered at Ewell in Surrey that the Roman township of which it is the modern representative was one of the more important of the stations which research has shown to have been strung out, probably for the convenience of travellers rather than for military purposes, along Roman Stane Street. A recent find of pottery fragments is of more than usual interest, owing to the fact that they are inscribed with names, of which indeed portions only remain, but sufficient to indicate that they have not previously been recorded among the names of the manufacturers of the pottery which was then being imported into Britain from the Continent in something like wholesale quantities. The fragments, which are described in *The Times* of November 8, were found in the south arm of Church Street, between High Street and the old church tower, and consist of two massive amphora handles, and the mouth portion of a mortarium. They are of buff ware and of second century type, the amphoræ of characteristic Roman form used for the transport of oil and wine, having thick, flat, ringed mouthpieces, made separately and joined to the neck and globular body. It is probable that the amphoræ of which these are fragments were made in Gaul. The handles were inscribed respectively *bvche* and *oropo*, while the mortarium is inscribed

innim; these, as already mentioned, have not previously been recorded among potters' marks of the period.

Archæological Research and the Prehistory of India

AN instructive general view of the results of his journeys of archæological reconnaissance in Southern Persia as a whole was given by Sir Aurel Stein before the East India Association on November 16, when the Marquess of Zetland, Secretary of State for India, was in the chair. As might have been anticipated, Sir Aurel stressed the need for further and intensive archæological investigation, the aim of which should be to throw light on the dark period covering the Aryan invasion and the beginning of the historic era, when Cyrus, in the middle of the sixth century B.C., extended his dominions to Gandhara, including the whole Kabul valley. It is evident, he pointed out, that the Aryan invader, as may be gathered from the Rig-Veda, had been familiar with a considerable portion of the Indo-Iranian borderland long before they settled in the Punjab. Sir Aurel stressed the gratitude due for the archæological discoveries of recent years in the Indus Valley, when so much relating to the period of the Aryan invasion must remain conjectural; but, he went on to say, his own explorations of the past few years in the great provinces of Kerman, Fars, Khuzistan and Kermanshah, right up to Kurdistan, had left no doubt about an essentially uniform chalkolithic civilization having prevailed here wherever physical conditions permitted of settled life. Yet nowhere on the ground visited had there been found remains filling the wide chronological gap between the chalkolithic mounds traced in such abundance and the numerous burial sites of Baluchistan and Makran, dating at the earliest from the last centuries before our era. Not until sites abandoned much later than Mohenjodaro had been explored could we hope to learn of the actual state of civilization prevailing in the Indus Valley and beyond at the time of the Aryan invasion.

Destruction of Chinese Centres of Learning

AFTER the great Japanese earthquake of September 1, 1923, when three hundred thousand persons lost their lives, and the buildings of the Imperial University in Tokyo were destroyed, including the loss of about seven hundred thousand volumes in the library, an influential British committee was formed to replace the English section of the library, not only as a token of British sympathy but also as a tribute to the intellectual life of Japan. The calamity which evoked this appeal was a natural one, and unavoidable, but it is ironical now to have to record that Japan itself has destroyed many schools, colleges and universities in China by air raids. We express no opinion upon the causes of the conflict, but we do deplore the barbaric methods of modern warfare which seem to permit no discrimination between combatants and the civilian population, and bring desolation to seats of learning as brutally as to fortified places or other military centres. We are therefore in complete sympathy with the righteous indignation expressed in a telegram organized by "For Intellectual Liberty", and signed in their individual capacity by more than one hundred members of twenty-two British universities, which was sent to the Minister of Education, Nanking, early last month. The replies received from the Shanghai Association of Universities and Colleges, and from representatives in Hankow of ten universities, show deep appreciation of the sympathetic message from England. "In name of world civilization," say the Hankow colleagues, "we thank you for your noble sentiment and moral support. We request you will give unswerving attention to prevent Far Eastern crisis and lend us further support in mobilising all British intellectual and humanitarian forces to the side of our common cause of international justice, which if humanity would exist must prevail."

Jews in Poland

THE Warsaw correspondent of *The Times* wrote on October 6 describing a system whereby Jewish students are being divided from 'Aryan' students in the lecture rooms of the Warsaw Polytechnic. Part of the benches have been marked for students belonging to a union almost exclusively controlled by 'Aryans', and others for the Jewish students' union, while a few seats for non-union students are left unmarked. The University of Warsaw has its seats numbered, and students sit according to the numbers on their identity cards. All 'Aryan' students, who have even numbers, occupy one half of the room. Unlike the Polytechnic, the University has no unmarked seats. It is stated that other educational establishments in Poland will probably follow suit. In the issue of *The Times* of November 18, appears a letter signed by Prof. George Barger, Mr. G. D. H. Cole, Mr. T. Edmund Harvey, Dr. Julian Huxley, Prof. Norman Kemp Smith and Prof. J. B. Trend, referring to the apparent surrendering of the authorities of the high schools and universities to the agitation of anti-Semitic students. They state that the Minister of Education, a year ago, gave an assurance that separate benches would never be introduced in the universities. They ask, "Will it enhance the good name or the welfare of the Polish republic if such a spirit of intolerance is officially allowed and deliberately fostered in the very institutions in which are trained our future legislators and administrators?"

Foot-and-Mouth Disease

THE outbreak of foot-and-mouth disease in the eastern counties of England has produced the usual crop of suggestions, in the form of letters to the daily Press, for dealing with this scourge. It is evidently not widely known that a Foot-and-Mouth Disease Research Committee is in existence, and published a substantial fifth Progress Report on its work so recently as early last summer (see NATURE, June 19, p. 1033). Replying to questions on November 15 in the House of Commons, the Minister of Agriculture, Mr. W. S. Morrison, referred to the work of this Committee, and stated that "the most effective

method of preventing the spread of infection is the prompt slaughter of affected animals and those in immediate contact". The work of the Research Committee is costing, he said, £16,000–£17,000 a year. In a written reply to a question, Mr. Morrison stated that the Government has paid out £4,900,233 in compensation for animals slaughtered on account of foot-and-mouth disease during the twenty years 1917–36. The Royal Society for the Protection of Birds has issued a circular letter asking if there is any evidence that starlings and other birds are responsible for bringing infection into England. The Research Committee, in its report referred to above, does not apparently favour the view that birds are responsible, but nevertheless Mr. Morrison declared that in the opinion of the Ministry, "the present outbreak is caused by migrant birds".

Monument to Wireless Pioneers

A GRANITE column has been erected by the Marconi Company at Poldhu Cove, Cornwall, on November 21, to mark the site of the former Poldhu wireless station. A plaque on the monument states that the Poldhu wireless station, designed by J. A. (now Sir Ambrose) Fleming, occupied that site from 1900 until 1933. A second plaque states that the Poldhu station was used for the first trans-oceanic service of wireless telegraphy, which was opened with a second Marconi station at Glace Bay, in Canada, in 1902. There is also a third plaque, which commemorates the fact that in 1923 and 1924 C. S. Franklin, inventor of the Franklin beam aerial, directed from there his short-wave wireless beam transmission to Marconi on his yacht *Elettra*, cruising in the South Atlantic. These experiments laid the foundation of modern high-speed radio-telegraphic communication to and from all quarters of the globe. Mr. H. A. White, chairman of the Marconi Company, who presided, said that Marconi had always realized that inventors working under the auspices of the company which bore his name do not usually receive adequate recognition. Most of the success of modern methods of radio-telegraphy and radiotelephony, and many other wonderful achievements in scientific technique, can be traced back to Sir Ambrose Fleming's invention of the thermionic valve in 1904.

The German *Autobahnen*

CONSIDERABLE attention has been given recently by scientific and technical workers to the remarkable system of new motorways now in course of construction by the German Government, at the invitation of which a delegation from Great Britain recently made a tour of inspection of the roads, both those in course of construction and also those now completed. Of the latter, 650 miles were opened to traffic on September 27, 1936, and it is stated that another 650 miles will be completed each year until a total of some 4,500 miles of new roads are constructed. Only mechanically propelled vehicles are permitted to use the *Autobahnen*, and the requisite land is purchased by the German Government, proprietors refusing to sell being expropriated, an exchange process between adjacent plots being arranged in such cases. The work gives employment to about 250,000 workers, and is financed directly by the Reich. Dual concrete carriageways, clover-leaf intersections, and transition curves suited to high-speed traffic are adopted, through and local traffic are segregated, and the mixing, placing, consolidation and finishing of the concrete surfaces is done by mechanical means throughout.

IT is understood that the delegation which visited these roads, composed of representatives of the Automobile Association, the Royal Automobile Club, and the British Road Federation, together with various technical experts, has been asked by the Minister of Transport to present to him its considered views on the German *Autobahnen*; and at the meeting of the Public Works Congress in London last week, a private session of the delegates was held at which the best method of preparing such a report was discussed. It is clear that although all who have seen these new roads have been greatly impressed by them as an engineering achievement, there is by no means unanimity of opinion in technical circles as to their applicability to conditions in Great Britain. Questions as to land values, possible effect on railway interests, the smaller size of Great Britain as compared with Germany, distribution of industry, and the strategical aspect, make the matter a difficult problem. It is suspected that methods easy of adoption in a totalitarian State may prove to be an entirely different proposition in Great Britain.

Richard Watson and the Constitution of Elements

PROF. H. A. HARRIS, of the Anatomy School, Cambridge, has directed our attention to a statement by Richard Watson (1737–1816), bishop of Llandaff and professor of chemistry at Cambridge, an account of whose work was recently given by Prof. J. R. Partington (*Chemistry and Industry*, 56, 819; 1937). Prof. Harris quotes from Watson's "Chemical Essays" (vol. 4, Essay 7), "Of the Transmutability of Water into Earth", in which he says "the diversities of bodies subsisting in the universe, will no longer be attributed to the different combinations of *earth*, *air*, *fire* and *water*, as distinct, undecompounded, immutable principles; but to the different magnitudes, figures, and arrangements of particles of matter of the same kind". This idea of a composition of particles of what were then believed to be elements from simpler particles in different arrangements and motions is to be found also in the "Sceptical Chymist" of Robert Boyle, written in 1661, in which he says: "The greatest part of the affections of matter, and consequently of the Phaenomena of nature, seems to depend upon the motion and the contrivance of the small parts of Bodies", and that "the difference of Bodies may depend meerly upon that of the schemes whereinto their common matter is put . . . so that according as the small parts of matter recede from each other, or work upon each other . . . a Body of this or that denomination is produced". In these statements of Boyle and Watson an idea of the present view of the structure of the elements is expressed.

Public Health in Great Britain

IN his annual report for 1936, published last week, Sir Arthur MacNalty, Chief Medical Officer of the Ministry of Health, points out that this year of the Coronation is also the centenary of Queen Victoria's accession, and he takes the opportunity to present an impressive statement of the remarkable progress that has been made in national health and in medicine in the past hundred years and of the amazing decline in mortality rates during that period. For 1936, the crude death-rate was 12·1 per 1,000 living, compared with 22·4 in the eighteen forties, the infant mortality rate was 59 as against 153, and the number of infants who died at less than one year of age was 35,425—less than half the number who would have died under conditions of as little as thirty years ago. The standardized death-rate from tuberculosis, respiratory and non-respiratory, was 657 per million living, compared with an average of 3,476 in the fifties of last century. There is an increase in the mortality from cancer, the number of deaths being 66,354, an increase of 1,847 on the previous year, which is a larger increase than that in 1935 over 1934. The maternal mortality rate was 3·8 per 1,000 live births, the lowest recorded since 1923. Reference is made to the importance of the consumption of a sufficient quantity of milk, described as "the key to proper nutrition", and commendation is expressed for properly operated milk bars. The report points out the risk of skin affections from the use of certain substances in lip-stick, hair-dye, face cream and other cosmetics, but observes that untoward results are relatively very few. Reference is made, in conclusion, to the national health services, the need for knowledge of these services, and to the intensive national health campaign organized and launched this autumn.

Photo-electric Control in Industry

AT the Nottingham meeting of the British Association, Mr. A. L. Whiteley contributed to Section A a paper on photo-electric control in industry. The photo-electric cell provides greater rapidity of action and a higher sensitivity than other light-sensitive devices. The greatest field for it is the talking picture industry, but this does not come under the subject of his paper. In industry the cells are usually made in standard sets called photo-electric relays, containing an amplifier circuit and a small contactor capable of making or breaking 15 amperes. An obvious application of this unit is counting objects on a conveyor belt or vehicles passing on a road. It can easily be used to make the pointer of an instrument actuate an external circuit on reaching a predetermined scale reading. Applications of this nature include automatic weighing of mass-produced parts and automatic termination of operations on high precision grinders when a mechanical gauge records that a certain diameter of the part operated on has been reached. It is also used to control street lighting according to variations in the intensity of the light. In many types of automatic wrapping and bag-making machines a continuous preprinted web of paper or "Cellophane" is fed to the machine at a high speed. It is necessary that positional relationship between the printed matter and the fold or cut be maintained. This is done by the response of the printed matter itself. The system is used abroad to maintain 'register' between the design and the perforations of postage stamps. It can be applied to record the intensity of the smoke coming from a chimney and the temperature of strip steel as it comes from the hot rolls of a rolling mill.

Blood Groups in Central Africa

MR. R. ELSDON-DEW, of the South African Institute for Medical Research, Johannesburg, has recently returned from his six months' expedition to Central Africa for research on the blood-grouping of the various native inhabitants of this region. In a communication to the Editor, he has included a long table of percentages based on his observations, for which space cannot be found. His investigations covered tribes of Rhodesia, Nyasaland, Tanganyika, Kenya and Uganda, reaching so far north as to the Nilotic peoples of the lowlands to the north-east of the great lakes. In all, thirty-four tribes or groups of peoples were examined, the numbers in each group ranging from one hundred and twenty-three (Tumbuka) to five hundred and seventy-six (Yao). In the majority of instances, however, the numbers were between four and five hundred, thus approximating in size to the eleven groups of natives of South Africa previously reported (see NATURE, July 10, 1937, p. 77), each of which numbered five hundred. These later results have not yet been analysed, so that any inference from the observations would be premature; but the percentages of the groups already worked out suggest that the analysis, when completed by Mr. Elsdon-Dew, will prove not only of great serological interest, but will also afford material of considerable significance for the ethnologist. These percentages follow the results of the earlier investigation in suggesting a striking tendency to the predominance of the *O* group among Bantu-speaking peoples. In the thirty-four sets of observations, the *O* group is less than 50 per cent in six instances only. In fourteen it ranges from 50 to 60 per cent, in twelve from 60 per cent to 70 per cent, and in two it is more than 70 per cent. Among the Wagogo the grouping is: *O*, 73·1; *A*, 19·6; *B*, 5·8; *AB*, 1·6; among the Vandau: *O*, 74·4; *A*, 13·4; *B*, 10·4; *AB*, 1·8. The highest percentage of *A* appears in the Wakamba: *O*, 53·3; *A*, 31·8; *B*, 12·9; *AB*, 2·0; and the highest *B* among the Lango (Nilote): *O*, 41·1; *A*, 27·6; *B*, 28·9; *AB*, 2·4.

Cables for 200,000 volt Pressures

FOR several years, research has been made in the laboratories of Callender's Cable Company with the object of designing an underground cable which will withstand the high electric pressures necessary for the economic transmission of electric energy over considerable distances. The new impregnated cable has now undergone a continuous test of 5,000 hours at 200 kilovolts and the application of numerous heat cycles during this period. According to the *Electrician* of November 19, it has also passed through the

official tests in Holland. This cable marks a very notable advance in the transmission of electric energy underground and will be most useful in the neighbourhood of towns and in populous districts. The dielectric is similar to that used in the 'solid' type of cable, but after the installation has been completed, dried nitrogen gas under pressure is admitted to the cable. The pressure used is 200 lb. per square inch and the gas finds its way along the cable in the narrow space between the dielectric and the lead sheath. All the dielectric is subjected to this pressure and so any void spaces which form in it during the working of the cable must contain gas at this high pressure. The electric strength of the void space will therefore be much greater than if the gas were absent. Very long continuous cables can be made in this way; no supplementary feed points are required. The strength required to withstand the high internal gas pressure is afforded by strengthening the lead sheath with copper tapes. The cable is treated just like the normal solid type cable during transport and installation. The point of entry of the gas is at the base of two sealing ends, and it is buried to a depth of about a yard. The cross-section of the conductor is about 0·65 sq. in. and the overall diameter is 3·46 in. The losses in the dielectric as compared with a solid cable have been reduced by 25 per cent, and there is no increase in the losses with rise of temperature.

National Institute of Sciences, India

AT a meeting of the Council of the National Institute of Sciences of India held on November 6 the following were elected fellows of the Institute: *Ordinary fellows:* Prof. Y. Bharadwaja, professor of botany, Benares Hindu University, Benares; Dr. B. L. Bhatia, principal, Government College, Hoshiarpur; Prof. G. R. Paranjpe, professor of physics, Royal Institute of Science, Bombay; Dr. H. Srinivasa Rao, assistant superintendent, Zoological Survey of India, Calcutta; Dr. K. Rangadharma Rao, reader in physics, Andhra University, Waltair; Prof. M. R. Siddiqi, professor of mathematics, Osmania University, Hyderabad-Deccan; Prof. A. C. Sircar, professor of chemistry, Presidency College, Calcutta; Dr. M. B. Soparkar, medical officer, Plague Research Inquiry, Haffkine Institute, Parel, Bombay; Sir Shah S. Sulaiman, judge of the Federal Court of India, New Delhi; and Col. F. C. Temple, chartered civil engineer, Calcutta. *Honorary fellows:* Prof. Ludwig Diels, director of the Botanical Gardens, Berlin-Dahlem, Germany; Sir James G. Frazer, London; Prof. Robert Robinson, Waynflete professor of organic chemistry, University of Oxford; Dr. C. M. Wenyon, director-in-chief, Wellcome Bureau of Scientific Research, London.

The Oxford Farming Conference

IN view of the interest aroused by the two conferences already held, the Oxford Farming Conference is to be established as an annual event. At the same time it has been decided that in future years the Conference shall not be confined to mechanized farming but shall provide a common meeting ground for farmers, research workers and others, at which any subjects of particular interest to British agriculture may be discussed. The next Conference will be held on January 4–7, 1938, and will deal mainly with the maintenance of fertility, with special reference to the Government's new agricultural policy and to the control of weeds and pests. Further information can be obtained from the Conference Secretary, 10 Parks Road, Oxford.

Electron Diffraction in Crystals

DR. P. P. EWALD, writing from the Crystallographic Laboratory, Cambridge, with reference to the note on the Nobel Prize award to Dr. C. J. Davisson and Prof. G. P. Thomson for work on this subject (NATURE, Nov. 20, p. 882), points out that W. Elsasser predicted the effect in 1925. Elsasser's work is mentioned early in a paper by Prof. G. I. Finch and H. Wilman entitled "Study of the Surface Structure by Electron Diffraction" published in *Ergebnisse der Exakten Naturwissenschaften*, **16**, 353–436 (1937), to which reference can be made for a review of the subject. In the course of two paragraphs dealing mainly with the work of Dr. Davisson and Prof. Thomson, it was neither possible nor desirable to attempt to survey the whole field of electron diffraction.

Observation of the Orionid Meteors

MOHD. A. R. KHAN informs us that he carried out observations of this shower at Begumpet, Deccan, on October 18–20, in spite of the difficulties attending strong moonlight. Altogether he observed forty-one Orionids, and his results again confirmed the easterly movement of the radiant, the positions of which on October 18 and 20 were respectively R.A. $6^h\ 5^m$, Decl. 15° N; R. A. $6^h\ 15^m$, Decl. 15° N.

Annular Eclipse of the Sun, December 2–3

AN annular eclipse of the sun will take place on December 2–3 but will be invisible from Europe. The path of annular eclipse, which will cross the Pacific Ocean, extends from long. 139·4° E., lat. 26·4° N. to long. 115·0° W. lat. 21·8° N.; the respective times of beginning and ending of annular eclipse corresponding to the extremities of this path are December $2^d\ 21^h\ 18^m$ and December $3^d\ 0^h\ 52^m$. Washington Island and Fanning Island in mid-Pacific lie on the track, the duration of the annular phase at these places being about $11\frac{1}{2}$ minutes.

New Minor Planet close to the Earth

HERR K. REINMUTH, Königstuhl, discovered an object, magnitude 10, on October 28, the position being R.A. $1^h\ 34{\cdot}2^m$, N. Decl. 8° 6′. It was moving rapidly—an indication of proximity to the earth. Other observations were made, but as these extended only over three days, the orbit derived is very rough. It is moving at a small inclination to the ecliptic, probably not exceeding 6°, and has a perihelion distance of about 0·6. The remarkable thing is the close approach to the earth at the end of October, namely, less than 700,000 miles. In *Mon. Not. Roy. Astro. Soc.*, **92**, 7 (May 1932), Dr. Davidson gave a

description of Minor Planet 1932 *HA*, which came to 6½ million miles from the earth, and predicted the discovery of other similar objects. Since then Adonis was discovered in 1936 and made an approach to the earth of 1⅓ million miles. The recent planet, 1937 *UB*, has made the closest approach of any, but it is quite possible that others may be discovered nearer still. These small objects present certain very interesting features in connexion with the evolutionary history of our solar system.

The Night Sky in December

AT the time of the winter solstice on December 22, the night lasts 16¼ hours in the latitude of London. The moon is new on December 2 at $23{\cdot}2^h$ and full on December 17 at $18{\cdot}9^h$ U.T. Mercury is an evening star setting at about 17^h, but the planet will be difficult to see, even at the time of greatest elongation (21° east) on December 12. Venus rises as a bright star in the late dawn. Mars, Jupiter and Saturn are evening stars, their respective times of southing in mid-December being $16{\cdot}3^h$, $14{\cdot}6^h$ and $18{\cdot}3^h$. Conjunctions between the planets and the moon occur as follows: Mercury on December 4^d 17^h; Venus on December 1^d 14^h; Mars on December 9^d 0^h; Jupiter on December 7^d 0^h and Saturn on December 12^d 1^h. At 22^h in the middle of the month, Algol, Capella, the Pleiades and Aldebaran are near the meridian. The variability of Algol may be watched about 1½ hours before and after the following times: December 3^d $0{\cdot}7^h$, 5^d $21{\cdot}5^h$, 8^d $18{\cdot}3^h$, 20^d $5{\cdot}6^h$, 23^d $2{\cdot}5^h$, 25^d $23{\cdot}3^h$, 28^d $20{\cdot}1^h$ and 31^d $17{\cdot}0^h$. Comet Encke is traversing the constellation of Ophiuchus; according to Crommelin's ephemeris given in *B.A.A. Handbook*, p. 34, the comet will reach perihelion on December 27. The Geminid meteors, at maximum frequency about December 10, have their radiant point west of Castor. On a clear night, two nebulæ that are very different in nature may be seen with the naked eye. The great nebula in Orion, situated within our stellar system, is a very extensive gaseous nebula nearly 600 light years from the earth. The great Andromeda nebula, 800,000 light years away, is one of the nearest two of a vast host of extra-galactic nebulæ extending into remotest space.

Announcements

THE Symons Gold Medal for 1938 of the Royal Meteorological Society has been awarded to Dr. G. M. B. Dobson, reader in meteorology in the University of Oxford.

SIR KINGSLEY WOOD has announced that an inquiry is to be held into the causes leading up to the outbreak of typhoid fever in Croydon, and the steps taken to deal with it. The inquiry will be held by Mr. H. L. Murphy, K.C., who will have as assessors Sir Humphry Rolleston, lately regius professor of physic at Cambridge, and a former president of the Royal College of Physicians, and Mr. H. J. F. Gourley, a past president of the Institution of Water Engineers.

DR. E. F. ARMSTRONG gave away the prizes and delivered an address at the annual prize distribution and conversazione of the Birmingham Central Technical College on November 17. He was then awarded an honorary associateship of the College. This distinction was inaugurated last year when it was given to Lord Austin, Dr. Sumpner, the first principal of the College, and Dr. C. C. Paterson.

THE RIGHT HON. LORD MACMILLAN will open the new buildings in Foster Court of University College, London, on December 1 at 2.45 p.m. After the opening ceremony, the new buildings (the Foster Court Library, the rooms of the Faculty of Laws, the Departments of Geography and Archæology, the Junior Laboratory of the Department of Physics and the Department of Zoology) will be open for inspection.

A SPECIAL programme of films on scientific subjects will be shown at the Academy Cinema, Oxford Street, London, on Sunday, December 12, at 2.30 p.m., under the auspices of the Scientific Film Group of the Association of Scientific Workers. Tickets, price 1*s.* and 1*s.* 6*d.*, may be obtained, prior to the day of performance, from the Secretary, Association of Scientific Workers, Kelvin House, 28 Hogarth Road, S.W.5, or from Film Centre, 34 Soho Square, W.1.

ON November 19, Capt. G. E. T. Eyston broke the world land speed record at Bonneville Salt Flats, Utah, in his car *Thunderbolt* by driving twice over the measured kilometre at an average speed of 312·20 miles per hour. Sir Malcolm Campbell held the previous record with an average of 301·47 miles per hour. *Thunderbolt* has two Rolls-Royce engines, each capable of developing 2,350 horse-power.

Flying Officer A. E. Clouston and Mrs. Kirby-Green returned to London from Capetown on November 20 in their Comet aeroplane, after making another record (NATURE of November 20, p. 388). The journeys were made in 5 days 17 hr. 28 min. The outward journey was done in the record time of 45 hr. 2 min., and the return journey in 57 hr. 23 min., the latter beating the previous best time by 39 hours. The round trip was faster by 88 hr. than any hitherto made. Another record was set up on November 22, when M. Codos and three companions flew from France to the Argentine in 48½ hours.

A REPORT has been prepared by a joint committee consisting of representatives of the British Rainfall Organization, the Institution of Water Engineers and the Royal Meteorological Society, appointed to consider methods for determining rainfall over any area. The report will be discussed at the general meeting of the Institution of Water Engineers to be held in the rooms of the Institution of Civil Engineers, Great George Street, Westminster, on December 10, at 2.15 p.m. Advance copies of the report can be obtained by members of the institutes concerned from their assistant secretaries.

A CHAIR of social medicine has recently been founded in the Paris Faculty of Medicine with Dr. Crouzon as its first occupant.

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. 935.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Photosynthesis of Carbohydrates *in vitro*

IT has been proved that carbohydrates are photosynthesized when a surface of pure nickel oxide coated with an adsorbed layer of hydrated carbon dioxide is irradiated with white light. The photosynthesis is accomplished by two successive photochemical reactions which are as follows:

(1) $4NiO.CO_2H_2O + h\nu_1 = 2Ni_2O_3.CHOH$

(2) $2Ni_2O_3.CHOH + h\nu_2 = 2Ni_2O_3 + CHOH$;

where $h\nu_1$ is a quantum of blue light ($\lambda = 4000$ A.), $h\nu_2$ is a quantum of red light ($\lambda = 6400$ A.), and CHOH represents a molecule of activated formaldehyde which polymerizes on the surface to a carbohydrate. These two processes are followed by a thermal or dark reaction:

(3) $2Ni_2O_3 = 4NiO + O_2$;

which takes place in the presence of hydrated carbon dioxide, with the result that the photosynthesis is continuous.

The first product of photosynthesis is a complex carbohydrate which is unstable and undergoes polymerization or condensation into a still more complex carbohydrate which is stable in solution. This second complex substance when thus formed in solution does not appear to be hydrolysed by acid or by diastase. If, however, this substance is deposited on a surface, it at once becomes capable of hydrolysis by diastase to reducing sugars. The stable complex carbohydrate appears, therefore, to be the hitherto unknown parent of a starch, since as the result of its deposition on a surface it becomes endowed with the characteristic property of starch, namely, its ready hydrolysis by diastase.

The stoichiometric relations shown by the two photochemical reactions indicate that the essential criterion of success is a surface of a true crystalline lattice of nickel oxide. Owing to the remarkable power which the hydroxide and carbonate possess of adsorbing hydroxyl ions, thereby becoming highly dispersed, considerable difficulty has been met with in preparing satisfactory surfaces of nickel oxide. Indeed all failures to achieve photosynthesis have been due to the dispersion of the nickel compound by alkali. This difficulty has now been overcome, and two methods of preparation have been standardized.

E. C. C. BALY.

University,
Liverpool.
Nov. 6.

Spectrum of Nitrogen and Atmospheric Pressure at High Altitudes

IN a series of experiments on the excitation of nitrogen bands by a controlled electronic bombardment, I have observed, as Dr. Kaplan did[1], the great modifications of the spectrum which accompany any change in the experimental conditions. As the pressure decreases, the intensity of the negative system of bands (emitted by N_2^+ ions) increases in comparison with that of the second positive system. On account of the rarity of collisions, the average energy of the exciting particles (ions or electrons) rises progressively and, at the same time, the probability of excitation of the negative bands becomes higher[2].

Dr. Kaplan proposes a simple method for obtaining the actual value of the atmospheric pressure between the boundaries of the auroral zone, that is, 100 km. and 1,000 km. After measuring the altitude of one aurora and observing its spectrum, it would be sufficient, in laboratory experiments, to seek for the pressure which permits the reproduction of a similar spectrum.

The idea is attractive, but we can oppose to it serious objections. Observation of auroral displays having a height of several hundreds of kilometres shows that the spectral composition is nearly the same at each point. This fact excludes any important influence of the pressure. Such an influence should enhance considerably, at the lower limit of the aurora, the bands of the second positive system of nitrogen, chiefly for low-altitude auroras. It seems that this change has never been observed. Moreover, it would be now difficult to question the electronic origin of the aurora. Admitting this view, I have recently shown that the only factor capable of altering the relative intensities of the radiations emitted is the energy of the electrons. Making use of photometric comparisons, as suggested by Dr. Kaplan, I even succeeded in assigning to the aurora a definite potential of excitation[3]. The development of this work is now going on at the Auroral Observatory of Tromsö.

In conclusion, the influence of the pressure on the composition of the afterglow spectrum is probably too complex a phenomenon to be considered as a source of precise information on the physical state of the upper atmosphere.

RENÉ BERNARD.

Institut de Physique Générale,
Université de Lyon.
Oct. 25.

[1] NATURE, **139**, 1112 (June 26, 1937).
[2] *C.R. Acad. Sci.*, **204**, 489 (1937).
[3] *C.R. Acad. Sci.*, **204**, 993 (1937).

Abnormal Zenithal Distribution of Cosmic Rays

MANY experimenters, and especially Auger and Ehrenfest, have shown that the intensity of cosmic rays, measured by counter coincidences, at different zenithal angles, is different from what it should be as deduced from the variation of vertical intensity at various heights in the atmosphere.

The intensity at a zenithal angle of 45° and at an altitude corresponding to a pressure of 0·7 atmosphere is about 30 per cent less than the vertical intensity at sea-level, unless the rays have to cross the same equivalent depth of air, supposing the composition of the atmosphere independent of altitude.

An absorbing layer, on the top of atmosphere, more absorbing than air for corresponding densities, would explain the anomaly, but the existence of such a layer is not easy to justify. I suggest that the whole of the anomaly would also be explained by taking into account the diffusion of cosmic rays in the air. A very rough calculation shows that a mean deviation of 20° in a screen of 1,000 gm. cm.$^{-2}$ is sufficient to explain the observed facts. Such a value for the diffusion does not seem to me to be in opposition with the known properties of the cosmic rays.

In seeking a quantitative justification of that hypothesis, a more elaborate calculation of the effect to be expected is now in progress, and will be published soon.

MAX G. E. COSYNS.

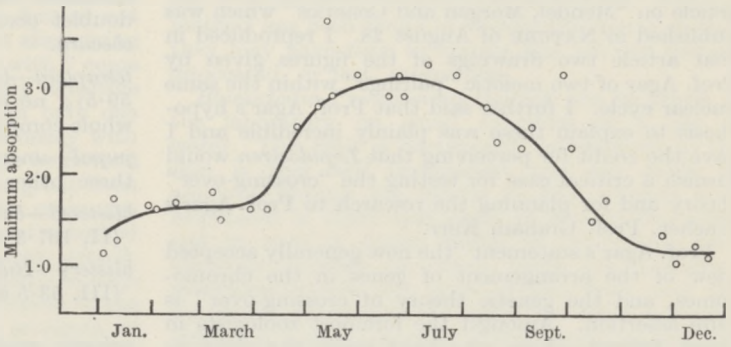
"Fondation Medicale Reine Elisabeth",
Brussels.
Oct. 26.

Annual Variation of the Absorption of Wireless Waves in the Ionosphere

A WIRELESS wave, incident normally on the ionized regions in the upper atmosphere, will, under suitable conditions of ionization and frequency, be returned to the earth from the *F* region. By the method described previously[1], the magnitude of the total absorption suffered by the wave in its atmospheric path ($\int k.ds$) may be determined as a function of the frequency of the wave at any given time of day. From measurements made at noon, with the emitting station at King's College, London, and the receiver at the Halley Stewart Laboratory, Hampstead, it has been shown that on any day the absorption has a minimum value, different from zero, provided that the frequency of the wave is not near the critical frequency for a reflecting region. As a critical frequency is approached, the absorption increases, but at other frequencies the minimum value of the absorption is independent of frequency, to the accuracy possible in this work.

This result indicates that there are two zones of absorption for waves reflected from the *F* region. The first is at the top of the wave trajectory and is of importance only at frequencies near the critical frequency for a reflecting region. The second is lower in the atmosphere, and the waves pass through it twice in their journey to and from the *F* region. The latter is principally effective in causing the minimum absorption mentioned above.

Some evidence of the variation of the minimum absorption from winter to summer has already been given. Since the publication of the previous results, however, the work has been continued and the annual variation in the magnitude of the absorption in the lower zone has been more definitely established. The complete results for the period, January–December 1935, are shown in the accompanying figure.



The lower zone of absorption is more absorbing in summer than in winter, the ratio of the midsummer value of $\int k.ds$ to the midwinter value being 2·27.

F. W. G. WHITE.

Canterbury University College,
Christchurch, C.1, N.Z.

L. W. BROWN.

"Brean", Moron Avenue,
Broomfield, Chelmsford.
Oct. 23.

[1] White and Brown, *Proc. Roy. Soc.*, A, **153**, 639-660 (1936).

Cytology of *Lepidosiren*

I HAVE just seen the issue of NATURE of August 28, in which Prof. E. W. MacBride refers to an early work of mine on the spermatogenesis of *Lepidosiren*. Although a reply after such a long interval loses much of its point, his use of that work as a disproof of the chromosome theory of heredity is so surprising that I feel that a reply is desirable.

My account of the longitudinal pairing of the homologous chromosomes in the zygotene stage, and the subsequent re-pairing of the temporarily separated ex-conjugants, is made to read very strangely by MacBride's using, as interchangeable terms, the pairing of the homologues prior to meiosis, and meiosis itself. But the main object of this reply is to state that I can see nothing in my description of the meiotic phase in this animal which is inconsistent with the now generally accepted view of the arrangement of genes in the chromosomes, and the genetic theory of crossing-over. The peculiarity in *Lepidosiren* consists merely in the unusually complete temporary separation of the ex-conjugants between the zygotene stage and the placing of the bivalents on the spindle of the first division. As I pointed out in my original paper (1911), this is in favour of the hypothesis that the pairing of the homologues performs a double function —that of allowing an interchange between them, and that of associating them together in the correct

relations for the meiotic division. Prof. MacBride does not believe in this double function; but he cannot logically cite the case of *Lepidosiren* (and similar cases which have been described) as evidence against it.

W. E. AGAR.

University, Melbourne.
Oct. 11.

PROF AGAR has read with insufficient care my article on "Mendel, Morgan and Genetics" which was published in NATURE of August 28. I reproduced in that article two drawings of the figures given by Prof. Agar of two meiotic "pairings" within the same nuclear cycle. I further said that Prof. Agar's hypothesis to explain these was plainly incredible and I gave the credit for perceiving that *Lepidosiren* would furnish a critical case for testing the "crossing-over" theory and for planning the research to Prof. Agar's teacher, Prof. Graham Kerr.

Prof. Agar's statement "the now generally accepted view of the arrangement of genes in the chromosomes, and the genetic theory of crossing-over" is pure assertion. Amongst the foremost zoologists in Great Britain—those who have really the right to speak on the specific problem—there is a widespread scorn of the whole 'gene' theory, and to say that this theory is "generally accepted" in view of the evidence given in my article, of the bitter regret of Johannsen that he had ever invented the word 'gene', of Mohr's statement that 'genes' responsible for mutations continually occur in all chromosomes and are all expressions of a lowered vitality, and finally of the view of the Development Commission that factors valuable to the former do not 'mendelize', is simply obscurantism—a deliberate shutting of the eyes to unwelcome truth.

E. W. MACBRIDE.

West Bank, near Alton,
Hants.
Nov. 3.

Gene Doublets as Evidence for Adjacent Small Duplications in *Drosophila*

IT is to be assumed—by analogy with the cell, the nucleus and individual chromosomes—that genes are always derived from parent genes, and are not created *de novo* from non-genic material. Evolution, as seen in the phenotype, must go hand in hand with an increase of the number of genes. Polyploidy as a method of increase of gene numbers is common in plants, but does not seem to have played an important part in the evolution of animals. The work of Bridges[1] on salivary gland chromosomes in *Drosophila* shows that small duplications, often adjacent, are common in *Drosophila*. They appear as 'repeat' sequences of very similar or identical bands; when extensive enough, these 'repeats' have a tendency to show somatic pairing within the individual chromosome.

If the interpretation of these 'repeats' is correct, they must have carried identical genes at the time they were formed. Development on divergent lines would lead to these genes gradually taking on different functions in ontogeny; but it is to be assumed that these functions would be similar in the early stages. If this is so, one would expect that genes with similar phenotypic effects would often occur as doublets in close proximity in the same chromosome. A survey of the genes of *Drosophila melanogaster* shows that there is in fact a considerable number of such cases, a number too great to be due to chance alone. The cases are most striking where the type of phenotypic effect is rare and the proximity close. Some examples are:

chlorotic—yellow (I, −0·1 and 0·0); also possibly *silver* (I, 0·1); only three other light body colours are known.

lozenge—almondex (I, 27·7 and 27·7 ±).

miniature—dusky (I, 36·1 and 36·2); the same doublet occurs also in *D. virilis*, *hydei* and *pseudo-obscura*.

tetraptera—bithorax—bithoraxoid (III, 51·3, 58·7 and 59·5); no other similar phenotype elsewhere in the whole complement.

pupal—unexpanded (II, 51 ± and 54 ±); only three other similar mutants known.

blistered—balloon (II, 107·3 and 107·4)
blistery—Bubble (III, 53·5 and 54 ±)
} Only six other similar mutants are known; two of these (*blot-bloated*, II, 55 ± and 59 ±) form possibly another doublet.

achaete—scute (I, 0·0 + and 0·0 + +).

It appears that the increase of gene number by small adjacent duplications is reflected in the non-random distribution of genes in the chromosome complement.

A detailed analysis will be published elsewhere.

HANS GRÜNEBERG.

Department of Biometry,
University College,
London.
Oct. 12.

[1] Bridges, C. B., *J. Heredity*, **26** (1935).

Interaction between Cell Nucleus and Cytoplasm

DR. CURT STERN[1] has suggested a new and ingenious method of showing what he says has not been shown before, that the genes inside the resting nucleus act on the cell outside it. This action, however, is implied by everyday cytological observations, and is shown by many particular demonstrations in plants.

In all hybrid plants four cells are produced at meiosis with genetically different nuclei, and their genetic differences may be readily seen to express themselves before the nuclei come to divide, since many of these nuclei, on account of their genetic defects, never divide again. In general terms, we may say that this is one of the conditions of apomixis in most plants. It is precisely where the potential embryo-sac nucleus fails to divide that it is replaced by purely vegetative development of maternal tissue. This happens in the versatile apomictic species of *Hieracium*, *Artemisia*, and most probably in *Rubus*, *Rosa* and elsewhere. Similarly on the male side we find that, in triploids and other forms with irregular segregation at meiosis, a proportion of the pollen grains have usually died before their first mitosis could have taken place. That this failure is due to the individual properties of the pollen grain is shown by the selected population of pollen grains (in regard to chromosome number) which actually reaches division[2]. Moreover, in two respects the pollen grains with different chromosome numbers often behave differently; first the length of the resting stage is different, so that in anthers taken at different times

we get a different sample of numbers[3], and secondly the pollen grains grow differently, so that the most unbalanced grains are disproportionately small[2].

Two examples of the resting stage action of the chromosomes are of specific genetic importance. In the hybrid *Œnothera* species, the nucleus which, on account of its position, is expected to produce the embryo-sac, fails to divide if it has a certain female-defective genetic constitution. A nucleus of the opposite type (segregated from it at meiosis) then divides and takes on its function[4]. On the other hand, in *Rhœo discolor* pollen grains are formed not only with the haploid 6 chromosomes but also, owing to non-disjunction, with 5 and 7. Those with 7 come to division, those with 5 being genetically defective do not[3]. This indeed is a rule to which only one exception is known. In spite of the frequency with which defective pollen grains are known to be formed at meiosis, only once has such a pollen grain been observed to reach mitosis, and this pollen grain was in the exceptional state of having remained attached to a complementary sister grain of the meiotic tetrad[5].

The evidence of the genetic individuality of cells raises another problem: How far is the choice of egg cell amongst the genetically different products of meiosis genetically determined, as it is in *Œnothera*? We know that the position of the embryo-sac cell is variable both where there are several mother cells, as in *Euphorbia*, and where there is only one, as in *Culcitium*[6]. We know also that the determination takes place after meiosis. We can therefore scarcely doubt that where important genetic differences distinguish the products of meiosis (as in triploids and structural hybrids), there will be a natural selection of favourable combinations in the egg cells. It remains to say that, where all the products of meiosis are not separated by cell walls (as in the *Lilium* and *Scilla* types of embryo-sac), it is impossible to decide from direct observation alone whether the egg-cell is not sometimes genetically instead of positionally determined. Breeding tests will be necessary. This is a question worth deciding, because selective fertilization in the wasp *Habrobracon*[7] indicates that separate nuclei within a single cell are capable of showing by their movements a genetic individuality distinct from that of the cell as a whole.

That the interface or monomolecular film which separates the nucleus from the cytoplasm protects it from mere dispersion and violent external fluctuations is obvious. That in doing so it acts as a semi-permeable membrane may be shown in various ways[3]. But that it could utterly preclude chemical intercourse and therefore genetic action between the outside and the inside is contradicted every time the nucleus of an egg divides on the stimulus of a sperm; for if the nucleus cannot act on the cytoplasm outside, how can agents outside act on it, determining its division or its death?

C. D. DARLINGTON.

John Innes Horticultural Institution,
Merton, S.W.19. Oct. 30.

[1] NATURE, **140**, 770 (1937).

[2] Darlington, C. D., "Chromosome Behaviour and Structural Hybridity in the Tradescantiæ", *J. Genet.*, **21**, 207–286 (1929).

[3] Darlington, C. D., "The External Mechanics of the Chromosomes, I–V", *Proc. Roy. Soc.*, B, **121**, 264–319 (1936).

[4] Renner, O., "Heterogamie im weiblichem Geschlecht und Embryosackentwicklung bei den Önotheren", *Z. Bot.*, **13**, 609–621 (1921).

[5] Belling, J., "The Origin of Chromosomal Mutations in *Uvularia*", *J. Genet.*, **15**, 245–266 (1925).

[6] Schnarf, K., "Embryologie der Angiospermen", *Hb. Pflanzenanat.*, **10** (1929).

[7] Whiting, P. W., "Sex Determination in Bees and Wasps", *J. Hered.*, **26**, 263 (1935).

Germination of Resistant Spores of *Blastocladia Pringsheimii*

LETTERS[1] have appeared in NATURE relating to the germination of resistant spores, and in them certain suggestions have been put forward as to the needs of such spores. With these in mind, controlled conditions have been found suitable for the germination of the supposedly resistant resting spores of *Blastocladia Pringsheimii* Reinsch. The lack of success of former attempts to germinate them is perhaps due to the use of spores either immature or desiccated. A simple method has been found of storing the spores so that they may have time to mature and yet not become desiccated, or lost, meanwhile.

Blastocladia Pringsheimii Reinsch can be grown in the laboratory on small tomatoes in a jar of water. This fruit is particularly satisfactory, as the skin is thin and transparent and can easily be removed bearing the fungus *in situ*. Fruits were inoculated in April and again in May of this year, and as soon as young plants of the fungus were observed growing on them (with the mycelium ramifying within the pulp of the fruit and the sporangia emergent in the water) the fruits were well washed in fresh water daily to keep down the bacteria. In June the fungus, now bearing a good crop of resting spores, was stored: the fruit skin bearing the fungus was torn into pieces which naturally rolled up, the outer side within the roll, so that the fungus, with such spores as still remained attached, was conveniently held within the roll of skin. Small flasks were taken and plain agar agar poured in, to a depth of half an inch. When this had set, the rolls of skin were placed on the surface and more agar agar was poured upon them to a depth of half an inch, making one inch depth all told. These flasks were left in the laboratory until September, when the pieces of skin were taken out and unrolled, exposing the mature, but not desiccated, spores. These germinated in water in about 24 hours. Other pieces of fruit skin were unrolled from time to time throughout October and into November, and a good percentage of the spores always germinated readily in water within a day or so.

This is not the place in which to describe the phenomena of germination and the habit of the germlings, an account of which will, it is hoped, appear shortly in a botanical journal.

ELIZABETH BLACKWELL.

Royal Holloway College,
Englefield Green,
London. Nov. 16.

[1] NATURE, **135**, 306 (Feb. 23, 1935); **135**, 546 (April 6, 1935); **139**, 758 (May 1, 1937).

Photodynamic Action of Carcinogenic Agents

IN a recent communication[1], we described the photosensitization of white mice by four carcinogenic agents. Since then we have sought other ways of demonstrating this reaction quickly, and have found that *Paramecium* is an excellent test object.

When benz-pyrene is ground up with tap water, and then spun for half an hour at 2,000 revs., a slightly opalescent liquid results containing not more than one part in 10,000. Paramecia will live in this in the dark for many days, but when placed in a glass cell, opaque to radiation of wave-length less than 3500 A., in sunlight or in front of a mercury

vapour lamp, they die and cytolyse in a few minutes. In tap water without benz-pyrene they withstand this treatment indefinitely, provided that the effect of radiant heat is excluded. Exposure of the benz-pyrene in tap water to sunlight or to the mercury vapour lamp for long periods of time does not render it destructive to Paramecia when they are afterwards added and kept in the dark. The use of colour filters shows that radiations between 3500 A. and 4100 A. are effective.

Paramecia which have been subjected to benz-pyrene overnight and repeatedly washed in tap water by slow spinning, retain their photosensitivity.

Similar reactions occur when dibenzanthracene is used, except that the Paramecia require longer exposures to light than in the case of benz-pyrene.

We have not been able to sensitize red corpuscles, and this suggests that the Paramecia may be ingesting colloidal particles, especially since keeping them for a day or two in the benz-pyrene preparation in the dark greatly increases their sensitivity. Colloidal particles are present in the preparations made as described, but whether any of the benz-pyrene is in solution has not yet been ascertained.

Shale oil and coal tar likewise sensitize Paramecia when a dilute emulsion obtained by shaking with tap water is used.

These results therefore confirm our previous findings with white mice.

J. C. MOTTRAM.
I. DONIACH.

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Northwood,
Middlesex,
and
Radium Institute,
London.

NATURE, 140, 588 (Oct. 2, 1937).

Selection and Mental Factors

METHODS of 'factorizing' the correlation-matrix of a team of intelligence tests have been described in the last few years by Spearman, Kelley, Thurstone, Hotelling and others, and it is of interest to observe what the influence of selection (including natural selection) in the population tested is on the number and nature of the 'mental factors' thus arrived at. I have discovered that if a team of $n = p + q$ tests has been resolved into r general and n specific factors which are normalized and mutually orthogonal, and if the variances and covariances of p of these tests are changed by selection, then the team can still be analysed into r generals and n specifics, but, in addition, a certain number l of new group factors will appear which, however, run through the p directly selected tests only. Further, these $r + n + l$ factors will again be uncorrelated and normalized, but they are in general different from the original factors. Selection can thus be seen creating, destroying and changing factors.

A fuller account of this, together with a rigorous mathematical proof which Dr. Walter Ledermann has made for me, will be published as soon as possible.

GODFREY H. THOMSON.

University,
Edinburgh.
Nov. 1.

Conversion of β-Phellandrene into a Derivative of α-Phellandrene

RECENT observations[1,2,3] of the co-existence of α- and β-phellandrenes in certain essential oils suggest a possible biogenetic relationship between these two terpenes. So far as we are aware no evidence of such an interconversion has been put forward although this might be anticipated from the apparently analogous conversion of β-pinene into α-pinene[4]. Since this lack of evidence may be due to the difficulty in detecting small quantities of one isomer in the presence of the other, it may be of interest to note that by condensation of maleic anhydride with *l*-β-phellandrene we have obtained a product which, from its melting point, mixed melting point and rotation, is apparently identical with the compound obtained from *l*-α-phellandrene[3]. The *l*-β-phellandrene employed was obtained from Canada balsam oil which has been shown to be free from α-phellandrene[3].

Further evidence of the identity of the product is being sought and the mechanism of the reaction is being investigated. A full account of the experiments will be published elsewhere.

N. F. GOODWAY.
T. F. WEST.

Sir John Cass Institute,
Aldgate, E.C.3.
Oct. 23.

[1] Berry, Macbeth and Swanson, *J. Chem. Soc.*, 1444 (1937).
[2] Duncan, Sherwood and Short, *J. Soc. Chem. Ind.*, **50**, 410T (1931).
[3] Goodway and West, *J. Soc. Chem. Ind.* (In Press.)
[4] Simonsen, "The Terpenes," **2**, 169 (1932).

Free Radicals in Solution

WITHIN recent years numerous investigations have proved beyond doubt the existence of free alkyl and aryl radicals, which are formed in the gaseous phase by the thermal or photochemical decomposition of suitable organic molecules. More recently, Norrish and Bamford[1] have devoted their attention to the production of free alkyl radicals in solution and have shown that the alkyl radicals R and R', formed by the photodecomposition of a ketone $RCOR'$, do not combine together, as in the gaseous phase, thus: $R + R' \rightarrow RR'$; $R + R \rightarrow RR$ and $R' + R' \rightarrow R'R'$, but mainly react with the solvent by abstraction of hydrogen with the formation of the simple hydrocarbons RH and R'H. Further, Walker and Wild[2] have studied the photodecomposition of diacetyl peroxide in solution (*cyclo*hexane or ethyl alcohol) and have shown that more methane and less ethane is formed under these conditions than when the decomposition is effected in the absence of a solvent. This reaction would also appear to involve the production of free alkyl radicals, which again have the characteristic property of abstracting hydrogen from the solvent.

More than three years ago[3,4], attention was directed to certain classes of organic compounds, namely, the diazo hydroxides, the nitrosoacylarylamines, the arylazotriarylmethanes, and the diacyl peroxides, which in many of their reactions showed characteristics indicative of a non-ionic fission into free radicals and either nitrogen or carbon dioxide. Strong confirmatory evidence for this view was published a year ago[5]. These communications showed that, as with the alkyl radicals discussed by Norrish and Bamford, marked differences were to be found

between reactions of aryl radicals in the vapour phase and the corresponding reactions in solution, since in the latter case the free radical invariably reacted with the solvent molecules. The characteristics of the phenyl radical, formed in the presence of a solvent, may be summarized as follows: (*a*) the free radical is extremely reactive and able to interact with almost the first molecule of any type encountered; (*b*) polymerization to diphenyl does not take place; (*c*) reaction with all non-aromatic hydrogen-containing solvents results in the formation of benzene ($C_6H_5\cdot + RH \rightarrow C_6H_6$); (*d*) reaction with all non-aromatic halogen-containing solvents results in the formation of a halogeno-benzene ($C_6H_5\cdot + R\text{Hal} \rightarrow C_6H_5\text{Hal}$); and (*e*) reaction with neutral aromatic liquids results in the formation of diphenyl derivatives in which the radical enters the aromatic nucleus at the *ortho* and/or *para* position with respect to *any* directing group which may be present.

A close similarity is thus revealed between the properties of alkyl radicals and those of aryl radicals in solution, and this correspondence gives striking support to the views originally put forward with reference to a non-ionic mechanism for certain reactions of the diazo hydroxides, the nitrosoacylarylamines, the arylazotriarylmethanes and the diacyl peroxides. In addition, various lines upon which the correspondence may be further extended immediately suggest themselves. The whole subject of reactions involving free radicals in solution will shortly be reviewed elsewhere.

D. H. HEY.

University,
Manchester.

W. A. WATERS.

University,
Durham.
Oct. 22.

[1] Norrish and Bamford, NATURE, **140**, 195 (1937).
[2] Walker and Wild, *J. Chem. Soc.*, 1132 (1937).
[3] Grieve and Hey, *J. Chem. Soc.*, 1797 (1934).
[4] Hey, *J. Chem. Soc.*, 1966 (1934).
[5] Waters, *J. Chem. Soc.*, 113 (1937).

Behaviour of Cylinders of Inflammable Gas in a Fire

IN a letter to NATURE[1], my friend, Prof. K. C. Bailey, refers to the evidence I gave before the Free State Government's inquiry into the Pearse Street fire of October 5, 1936, where, owing to the failure of the water supply, three firemen lost their lives through carbon monoxide poisoning. Prof. Bailey's success in extinguishing a flame with a burst of gas from a high-pressure container will scarcely surprise anyone who has tried to light a gas jet (at only a few inches water-pressure) by holding a kindled match directly in its path. A draught of air, also, will extinguish a candle; though it might perhaps be expected to contribute to the combustion. A draught does not extinguish a blast-furnace.

Prof. Bailey's theory accounts for the two explosions that were heard by so many witnesses as being due (1) to the bursting of the coal-gas cylinder, and (2) to the chemical explosion of the atmosphere then constituted. Actually the evidence is perfectly clear that the coal-gas cylinder yielded plastically, bulging and dividing into a "pair of trousers". All the witnesses were shown this cylinder at the time of the inquiry.

Now the companion oxygen cylinder burst in such a manner as to blow part of its wall away; yet this rupture, though it must have been percussive in the highest degree, is apparently held to have been inaudible, and the discharge of 120 cubic feet of oxygen into a highly super-fuelled atmosphere is not, apparently, held to have been a similar cause of explosion.

There is no doubt, surely, that whatever cooling took place in the body of the liberated coal-gas, its periphery must quickly have attained ignition temperature in the burning inferno which Prof. Bailey postulates. Then it must have moved as a flame-mantled blimp towards and through the great ventage whence a glass roof had fallen in at some time before the two explosions.

OLIVER C. DE C. ELLIS.

22 Tree Root Walk,
Sheffield, 10.
Oct. 29.

[1] NATURE, **140**, 503 (Sept. 18, 1937)

Points from Foregoing Letters

THE synthesis of a complex carbohydrate from carbon dioxide and water in the presence of light, by means of a specially prepared nickel catalyst, is reported by Prof. E. C. C. Baly. The compound, when deposited on a surface, can be hydrolysed by diastase, and hence it may prove to be the parent of a starch-like substance.

Although the spectrum of nitrogen excited by electron bombardment varies greatly with pressure, R. Bernard finds that the spectral composition of auroras having a height of several hundred kilometres remains nearly constant. He considers, therefore, that the energy of the electrons and not pressure is the factor affecting the relative intensity of the radiations emitted.

M. G. E. Cosyns suggests that the anomalous distribution of cosmic rays coming from different directions (zenithal angles) may be explained by taking into account the diffusion of cosmic rays in air.

Dr. H. Grüneberg gives a list of pairs of mutations of the fruit fly, *Drosophila*, which have very nearly related characters, such as chlorotic-yellow, and points out that the corresponding genes occur as doublets in close proximity within the same chromosome. He suggests that new genes arise by small adjacent duplications followed by differentiations.

Dr. C. D. Darlington states that the genetic action of chromosomes in the resting nucleus on the cell may be inferred from the rapid death of pollen grains and embryo sacs with defective chromosome complements in hybrid plants.

Further to the experiments on the sensitization by certain cancer-producing substances of mice by light, Dr. J. C. Mottram and Dr. I. Doniach find that paramecium is destroyed by benz-pyrene suspensions (1 in 10,000) in the presence of light of wave-length between 3500 A. and 4100 A., but not in the dark.

Dr. D. H. Hey and Dr. W. A. Waters point out that the reactions of free alkyl radicals produced photochemically in solution are exactly similar to those of free aryl radicals which they consider to be formed when certain classes of complex organic molecules decompose.

Research Items

Intoxicants in Sarawak

MR. E. BANKS, curator of the Sarawak Museum, has made a study of the customs and behaviour of Sarawak pagan tribes in relation to native alcoholic drinks (*Sarawak Mus. J.*, 4, 4). It is usual among the pagan tribes to offer visitors to the long house a drink made mainly from fermented rice and occasionally from sweet potato, sugar-cane, or even fruit. This helps to place hosts and guests at their ease and assist free discussion of intimate matters. The women, though brewing the liquor, drink sparingly, if at all, fearing intoxication. The Land Dayaks of Kuching and Salong prepare a very sweet yellow-brown drink from a reddish orange fruit. This contains 23 per cent alcohol. These people, who are much repressed, are abstemious from fear of intoxication. If they become intoxicated, they are never quarrelsome, but fall asleep. The Sea Dayaks, or Iban, brew a sweet and milky drink with about 20 per cent alcohol; but they drink rarely and are singularly sober. This, however, is due largely to thrift and lack of opportunity; and European drinks, if free, are absorbed in large quantities by both men and women without noticeable effect. Drink plays a very large part in the life of both Kayan and Kenyah, no birth, death, or marriage ceremonies being complete without a liberal supply of drink for all, including visitors. The same applies to agricultural ceremonial. Cooked rice mixed with water is the mainstay of the drink, which is brewed by women, but with great uncertainty as to what the product will be, both in strength and flavour. Fruit, berries and a yeast are added to the rice liquid, the alcoholic content in samples tested ranging from 18 to 23 per cent. Strong alcohol is obtained from this liquor by distillation. There is considerable etiquette in drinking, and the ritual is prominent in their customs. They drink frequently and jovially, and hold their drink well. The Kelabit and Murut, on the other hand, living farther north and at a considerably greater altitude—3,000–4,000 ft. where the nights are cold—are mighty drinkers; but whereas the Kelabit shows no ill-effects, the Murut is drinking himself out of existence.

Biological Action of X- and γ-Rays

THE keynote to "Some Quantitative Aspects of the Biological Action of X- and γ-Rays" by C. M. Scott (Med. Res. Coun. Special Report Series No. 223. London: H.M. Stationery Office, 1937. Pp. 99. 1*s.* 6*d.*) is the term quantitative, for the author has summarized and criticized the work of radiologists where quantitative, rather than qualitative, results have been claimed. All the important effects of X- and γ-rays upon living tissues come under consideration in Part 1—some at length, others more briefly. The author's chief aim is to direct attention to our scanty knowledge of the nature of the primary action of these rays, at the same time maintaining that this action is largely exerted on the nucleus of the cell and thereby on the cell processes that control growth. Part 2 contains detailed description of the author's experimental work upon the effects of X-rays and radium on the isolated frog's heart and upon the eggs of *Calliphora erythrocephala*. The general plan of these experiments might well serve as a model for others, showing as they do the essential features of quantitative work. Mr. Scott's conclusions will not be accepted by all, but they will be treated with the respect that their sincerity warrants, and his views generally will prove a stimulant to research.

The Protein of Yellow Enzyme

THE importance of the 'yellow enzyme' is considerable: its identification as lactoflavin-5′-phosphoric acid, of known structure, coupled with a specific protein, has been one of the outstanding achievements in the laboratory of recent years. A successful attempt has now been made by Prof. Richard Kuhn and P. Desnuelle of Heidelberg to establish the nature of the protein (*Berichte*, 1907; 1937). Normally such an analysis requires very considerable quantities of material, whereas the yellow enzyme is known in milligrams rather than in grams. The absorption process of Weygand has enabled somewhat larger quantities of the pure yellow enzyme to be prepared so that the amino acids obtained on acid hydrolysis of the protein could be estimated quantitatively. To do this the latest microbiochemical technique has been applied, colour reactions for the individual amino acids have been used to estimate them photometrically, and the hexone bases were separated by electrodialysis. The achievement is a striking one and an outstanding example of the delicacy and the advantage of this new technique. So far, no particular variation from the known proteins is shown either in the nature or the quantity of the amino acids—65 per cent of the nitrogen has been identified. The hexone bases are of importance, since the protein is attached through basic groups to the rest of the molecule in two places. It may be of significance that the total of histidine, arginine and lysine is the same as in the protein of hæmoglobin, but their relative proportions are entirely different.

Insects and Mites in Stored Grain

THE attention of entomologists is directed to Miscellaneous Publications 258 (July 1937) of the United States Department of Agriculture, written by Messrs. R. T. Cotton and N. E. Good. This 80-page brochure lists the insects and mites associated with stored grain and cereal products from all parts of the world. Under each species is given its geographical range, habitat, food habits, its parasites and predators together with its relative importance as a pest: wherever necessary, references to literature are also given. The various invaders of grain, etc., are classified according to their status or, in other words, whether they are of major or minor importance or only incidental pests. They are also classified taxonomically, which facilitates easy reference from that point of view.

Antarctic Vegetation

AN interesting geographical extension of the scanty flora of the Antarctic regions is noted in an article in the *Polar Record* of July on the work of the R.R.S. *Discovery II*. Until recently, the only two flowering plants, a grass (*Deschampsia antarctica*)

and a small caryophyllaceous plant (*Colobanthus* sp.), recorded were poor and stunted specimens from the South Shetlands and the north-western part of Graham Land. These two species are now recorded from Signy Island which lies on the south of Coronation Island, the largest of the South Orkney group. The previous search by the *Scotia* expedition for these plants on Lauric Island, another island of the group, had proved fruitless. The discovery of a liverwort on Signy Island is another extension of geographical distribution in the Antarctic.

Origin of Lead Ores

THIS problem has been recently discussed in the light of atomic weight evidence by Arthur Holmes (*Econ. Geol.*, 763–782; 1937). The lead dispersed through rocks in minute quantities is called rock-lead; it consists partly of common lead, originally present in the rock material, and partly radiogenic lead, generated in the same rock material by the disintegration of uranium and thorium during geological time (taken as about 2,000 million years). From the available determinations of lead, uranium and thorium in various types of rocks, it is shown: (*a*) that the average atomic weight of granitic rock-lead should have decreased progressively during geological time from 207·21 at the beginning to 207·14 at the present day; (*b*) that the average atomic weight of basaltic rock-lead should have similarly decreased from 207·21 to 207·10. The atomic weight of rock-lead concentrated in cotunnite from the 1906 magma of Vesuvius is 207·05, a result which confirms the inference that rock-lead has an atomic weight significantly lower than that of common lead. The atomic weight of common lead, that is, the lead concentrated in ore-deposits, is found to be 207·21 ± 0·01 and—as far back as 1,300 million years—to be independent of the geological age of the ore. It follows that such ore-lead cannot have been derived from granitic or basaltic rocks, or from the sediments formed from such rocks, and that it has no genetic connexion with acid or basic magmas. Ore-lead must, therefore, have ascended from depths below the sialic and basaltic layers of the earth's crust. The view of the late J. W. Gregory that "the source of the ores appears to lie in a zone deeper than that of the ordinary igneous rocks" is thus largely confirmed, so far as lead ores are concerned. The data for peridotites are too few to justify the extension of this generalization to ultrabasic rocks and magmas.

Earthquakes off the Coast of Northern California

THE coastal portion of California is one of the most interesting earthquake regions in the world. This is due to the connexion of many of its earthquakes with the remarkable San Andreas fault that traverses the whole length of the State. As Prof. Byerly points out in a valuable paper (*Bull. Seis. Soc. of America*, 27, 73–96; 1937), recent earthquakes cluster in three segments of the fault, a northern one in the counties of Del Norte and Humboldt, a central one from the Golden Gate to San Luis Obispo county, and a southern one in the Imperial Valley; while the regions of great displacement, such as that in 1906, occupy the intervening portions. The frequent occurrence of earthquakes with their centres at sea off Humboldt County has led to the suggestion that there may be another active portion along a linear extension of the fault beyond Punta Arenas. The greater part of Prof. Byerly's paper is devoted to the determination by two methods of the epicentres of three earthquakes in 1934, 1935 and 1936. The positions obtained by the methods are in fair agreement. As, however, the distances of the points nearest the continued fault-line are about 23, 15 and 45 miles, the author concludes that there is no real connexion of the earthquakes with movements along the San Andreas fault.

Carbonization of Coal at Low Temperatures

THE Department of Scientific and Industrial Research has published a report issued by the Director of Fuel Research of a test made on the plant of the National Coke and Oil Co., Ltd., at Erith, for carbonizing coal at low temperatures. The process consists in carbonizing a paste of about equal parts of coal and oil in rotary cylindrical retorts, the oil produced by the plant itself serving as vehicle, after removal of spirit. About 15 cwt. of coke was obtained per ton, ranging in size from 4 in. downwards. It was dense, easily ignitable and easy to burn in open fires. About 10 cwt. of this was less than $\frac{3}{4}$ in. and was crushed and briquetted. 8·9 gallons of refined mixed spirit was obtained per ton of coal and, in addition, oil suitable for Diesel engines. Both caking and non-caking coals were carbonized in the plant, the retorts of which were externally heated, and for this purpose all the gas produced in the process is required.

Infra-red Absorption of Hydroxy Compounds near 3μ

MANY compounds containing the hydroxyl group have a sharp absorption band at 2·75μ and another wider band about 3μ, attributed to associated molecules. This association band diminishes on dilution with a non-polar solvent and on increasing temterature. An investigation of these bands for phenol and certain aliphatic and aromatic alcohols in solutions of carbon tetrachloride and other solvents is reported by Drs. J. J. Fox and A. E. Martin (*Proc. Roy. Soc.*, A, 162, 419; 1937) and the results are characterized by the same interest, thoroughness and comprehensive treatment which has been a distinctive feature of previous infra-red work carried out in the Government Laboratory. Phenol has been investigated in several solvents, and the intensity of its association band is proportional to the number of molecules not contributing to the shorter wave length band. Equilibrium between single and double molecules is set up at moderate concentrations, and the forces acting between such molecules are considered on the basis of London's theory of intermolecular forces. With chloroform as solvent, the intensity of the association band is reduced to about half the value with carbon tetrachloride. For both solvents association is reduced by increased molecular complexity in the series, PhOH, $PhCH_2OH$, Ph_2CHOH, Ph_3COH. Factors affecting the locations and intensities of the bands in these compounds are discussed. The effects shown by normal and tertiary butyl alcohols are compared and data for stearyl and cetyl alcohols are given. Influence of structure on the CH vibration bands has also been studied. Aliphatic CH bands for CH, CH_2, and CH_3 groups have constant intensity for the CH linking in each molecule and it is distributed among the one, two, or three CH linkings attributed respectively to each group; whilst in aromatic alcohols the positions of the CH bands remain unaltered, but relative intensities are not always retained.

An International Conference on the Theory of Probability

THE Faculty of Science, University of Geneva, organizes periodical international conferences on various branches of mathematics. A special committee presided over by Prof. R. Wavre, chooses and invites lecturers. Visitors are also welcomed at these conferences, and invited to take part in the discussions.

This year it was the turn of the theory of probability. The Conference lasted the whole week, October 11–15. It was opened by Prof. R. Wavre and then addressed by its chairman, Prof. M. Fréchet, of the Sorbonne, who outlined the trends and conflicting tendencies in the recent history of the theory of probability. Next, fifteen other papers on various subjects and various modalities of the probability theory were read and discussed in the presence of fifty to one hundred listeners. It is hoped that the contents of the papers presented at the Conference, and also those of the authors who were prevented from attending, will be published soon, as separate numbers of the series "Actualités Scientifiques" (Hermann et Cie., Paris).

The purpose of these conferences is to mark and sum up the latest achievements in the particular branch of mathematics under discussion. Therefore the general tendency in papers presented was not necessarily to state and prove some particular theorems, but rather to describe the state of various theories, without going into details of proofs. It need scarcely be said that this contributed greatly to the interest of the proceedings, and it was possible to build up a general outlook on what is being achieved and what is being aimed at in the theory of probability. Below we give a subdivision which suggested itself to us. It will be realized that any such classification is only approximate and must be influenced by personal opinions. Therefore, while indicating the names of the authors of papers which seem to belong to one or the other of the described directions, we wish to emphasize that we ourselves could not recommend this classification as a totally objective one.

First of all we may mention three different directions of work concerning the very foundation of the theory, that is, the definition of probability. As is the case with many other mathematical sciences, the theory of probability is designed to provide a model of certain processes in the outside world. Here we have the first point of subdivision. There are theories aiming at representing primarily (*a*) the machinery of frequencies in repeated trials and (*b*) the changes in the state of mind of the observers. Theories of the first kind have for their object to use probabilities $p_1, \ldots p_k$ of some events, supposed to be known, in order to calculate the probabilities $P_1, P_2, \ldots P_m$ of some other events, but are totally indifferent as to how the values of $p_1, p_2, \ldots p_k$ can be obtained in practice. On the other hand, this is the very question which seems to be central in the other theory (B. de Finetti).

The theories of group (*a*) (W. Feller, M. Fréchet, J. Steffensen, A. Wald) are again subdivided. First of all there are what could be called the modernized classical theories, in which the probability is considered as an additive or an absolutely additive set function. Next there are theories where the probability is being defined as a limit of a relative frequency, the existence of which is being postulated. All these directions were represented at the Conference, and there were lively discussions. The absence of F. P. Cantelli and that of R. v. Mises, who are important representatives of the directions mentioned and had promised to read papers, was much regretted.

Most of the work which did not directly concern the foundations was on the modernized classical theory. Here again several points of subdivision suggest themselves. One category represents the work on the perfection of the theory either by bringing in the mathematical accuracy in a field already more or less treated or by deducing new facts. Such were the papers on a new theorem concerning the law of big numbers (H. Cramér), on the probability problems in mechanics (E. Hopf), on the arithmetic of probability laws (P. Lévy), and on the conception of independence (H. Steinhaus). A paper promised by A. Wintner was greatly missed by the Conference.

The original programme of the Conference included a number of papers on what could be called random curves, which is a new and most important branch of the theory of probability connected with that of Markoff chains. It was much regretted that the respective authors (S. Bernstein, V. Glivenko, A. Kolmogoroff, V. Romanovsky and E. Slutski) were not able to be present, but it is hoped that their work will be published with the others. The only paper in this direction, on the chains with complete connexion, was given by O. Onicescu.

Further work concerned the applications. An extremely interesting paper was read by W. Heisenberg on the probability statements in the quantum theory of waves. His most remarkable conclusion was that modern physics seems to require a new branch of mathematics involving the conception of an absolute minimum of distance. G. Pólya discussed certain simple schemes of random experiments which, by some ingenious passages to the limit, lead to partial differential equations and distribution functions applicable in physics and engineering. On similar lines also was the paper by B. Hostinsky. These were really papers solving problems of mathematical statistics as defined by Borel: to find a system of random experiments (by drawing balls or tossing coins) such that the most probable frequencies of their results would approach closely those observed in some field of application.

Papers of a still more statistical character were given by E. L. Dodd, on the estimates of regression coefficients based on the principle of maximum likelihood, by J. Neyman, on the theory of statistical estimation conceived as a problem in classical probability, and by N. Obrechkoff on the cases of convergence of the Charlier series. We regretted the absence of C. Jordan, who promised a paper on correlation.

The programme of the Conference included receptions and parties given by the Société de Physique et d'Histoire Naturelle, by Prof. Kurt Meyer, by the Faculté des Sciences and by the organizing committee of the Conference. During these receptions

we were cordially welcomed by Prof. G. Tiercy, dean of the Faculté des Sciences, and by Prof. F. Chodat, acting for the president of the Société de Physique et d'Histoire Naturelle. The receptions were much enjoyed, and offered a precious opportunity of personal contacts and exchange of opinions and criticisms in private. When we were driven into the Jura and, having turned a corner, saw the Lake of Geneva far below the road, and in front of us, behind the Lake, the glittering tops of the Alps, the exclamations of delight were mixed with unfinished sentences concerning point sets, measure, Bayes, etc. The cordiality of the hosts, among whom were Profs. H. Fehr, D. Mirimanoff, G. de Rham, and R. Wavre, culminated at the closing dinner on Friday night, after which the guests departed, carrying with them happy memories of the Conference and a feeling of gratitude to the hosts and hopes of future similar occasions.

It was announced that another conference on the theory of probability will be held soon in Geneva, and will deal more especially with problems of various applications.

E. L. DODD.
J. NEYMAN.

The Birch 'Forests' of Greenland

By Dr. Nicholas Polunin, Department of Botany, University of Oxford

DURING the past summer of general botanical work in the Julianehaab district—climatically the most favourable part of Greenland—special attention has been paid to the history and present-day ecology of the oft-mentioned but little known Greenland 'tree' birch (*Betula pubescens* sens. lat.).

In 1933 I was able to show[1] that in Lapland the roots of the nearly related (perhaps conspecific) *B. odorata* Bechst. are able to conduct water actively through at least half a metre of hard-frozen soil, and moreover that where the roots are unable to extend below the frozen surface layer, this generally dominant plant is absent or at least fails to attain proper 'tree' form[2]. Much the same seems to be true of the Greenland *B. pubescens* which, however, scarcely attains the form or proportions of a real tree. Its 'forests', which are generally confined to the most sheltered fjord-head regions, consist for the most part of straggly bushes 2–4 metres in height. Moreover this scrub, at least in the district visited, appears almost always to be interrupted at more or less frequent intervals by patches of lower Salices or dry lichen or herb associations—most often due to biotic disturbance but sometimes, it seems, to natural edaphic or other environmental conditions. Occasionally an individual birch will be found reaching a height of 5½ metres or a little more, while the maximum stem diameter observed was 25 centimetres. These larger trunks and indeed almost all the 'trees' are gnarled and prostrate or obliquely ascending near the butts[3], being often twice as long as they are high and generally growing several from a stool and away from the direction of the worst "foehns".

These peculiar winds, descending with gale force from the lofty ice-cap, may be so warm and lasting as to melt all the snow even in the dead of winter and kill whole patches of the shallow-rooted *Empetrum* and other 'heaths' by desiccation when the soil is frozen near the surface and water cannot be absorbed to make good that which is lost by transpiration from the aerial parts. The result is that the ground vegetation in many places consists largely of cryptogams which are temporarily able to withstand almost complete desiccation. But the dominant birches—and probably also the Salices—have roots going down far below the deepest level (60 cm.) to which, so far as I have been able to determine by digging in early summer and questioning the natives, the soil is liable to be frozen in the areas of the largest birches in winter. (During the first week of August I was unable to find any ground-ice or temperatures below 2–3° C. even down to depths of nearly 2 metres in the bogs in Tunugdliarfik Fjord.)

There can be no reasonable doubt that the 'trees' are, as in northern Lapland[4], limited to areas where the soil is only frozen superficially in winter, and that they can withstand the extremely inimical springtime foehns—which may cause the buds to swell and sometimes burst into leaf, yet even small twigs are rarely killed—only by absorbing water from lower levels and conducting it up through the frozen layers; for rootlets are to be found almost everywhere extending to 1–2 metres, at which depth sandy soil is in summer almost as warm as near the surface. Such regions, with relatively warm or at least unfrozen conditions of subsoil throughout the year and supporting tree or tall bush growth over considerable areas, are by the biologist to be classed as Subarctic rather than truly Arctic in type; for in the Arctic the soil is permanently frozen to a great depth, only the surface layer thawing out in summer.

The presence or absence of a permanently frozen subsoil, which itself depends upon local physiographic as well as general climatic conditions, may largely determine the northern limit of tree growth in the world, at least in regions of relatively oceanic climate; it may perhaps also afford a convenient standard for distinguishing between the Arctic and Subarctic where latitude and other criteria fail.

The theory propounded by Ostenfeld[5] but already strongly refuted by Porsild[6] that the 'tree' birch was introduced to Greenland from Iceland by the Nordic colonists of the tenth century is quite untenable on geobotanical, sub-fossil[7] and even written historical grounds. The Greenland 'forests', the dominants of which often approach 100 years in age and harbour junipers 200–300 or even more years old[8], appear instead to be relics of a more genial postglacial warm period that probably lasted until about 2,000 years ago, according to verbal information from Prof. Knud Jessen and Dr. J. Iversen of Copenhagen, who have each carried out independent investigations on the sub-fossil strata of different parts of south-west Greenland. These authorities and Dr. M. P. Porsild, who has spent most of the last thirty-one years in Greenland as director of the Danish Arctic Research

Station on Disco Island, moreover agree with me that there is no real evidence, either archæological or otherwise, for the popularly supposed serious deterioration of climate since the time of the Nordic colonization.

What was probably the strongest suggestion of such a change resulted from the discovery of the coffins of some buried Norsemen permeated by roots of plants but all frozen in summer[9]; but that was only in one place far out on the exposed ocean coast and in a bad year and other quite unusual circumstances, as the late Fridtjof Nansen quickly pointed out in objecting to this suggestion; moreover, the presence or absence of frozen soil conditions depends on a number of factors of which aerial temperature is only one[10]. That the climate may have become somewhat drier and a very little cooler since the advent of the Norsemen seems quite possible, and indeed just around Eric the Red's estate at Qagssiarssuk where the birch 'trees' were extensively cleared by the Norsemen they have failed to reappear even in the 400–500 years since the dying out of the colony. But there is no evidence of a change great enough to have been, at the very most, more than one factor contributing in some degree to the downfall of their once flourishing civilization.

Thus the peat deposits show no signs of any important change in the summer temperature since long before the advent of the Norsemen[11], while even if the climate has become drier the conditions are still damp enough to support over large areas in this district luxuriant grassy herb communities that afford some of the best summer pasturage I have ever seen! Moreover the outlawed Eric, in what has wittily been termed 'the first real-estate venture', called the country *Groenaland* 'the green land' merely in order that he might the more easily attract colonists from Iceland[12]—which suggests that the notoriously inhospitable aspect of the coast is no mere present-day phenomenon. Finally, and perhaps most significantly of all, the tree and bush communities in some places show to this day what is with little doubt the same delimitation as they were given by cutting by the Norsemen and grazing by their domestic animals. It is inconceivable that the extremely fine equilibrium existing between these 'higher' communities on one hand and the *luxuriant* alternating patches of grass and herbs on the other could have been maintained in the face of any appreciable climatic vagaries, much less a profound change; while even if this remarkable community delimitation can only with fair certainty be stated to date from the final disappearance of the Norsemen, it seems highly probable that it is the result of long lasting biotic impress and hence dates from well before that time. Even the temperature of the earlier warm period, which presumably corresponded to the sub-boreal of Europe, may have been only slightly above that of the present day, for no evidence has yet been found of the occurrence in Greenland in post-glacial times of any plant formation or species which does not live there now.

Since the above was written Prof. Jessen has informed me (1) that he has found plentiful fruits of *Betula publescens* s.l. in peat layers from south-west Greenland that were laid down long before the advent of the Norsemen, which finally proves that the plant is indigenous; and (2) that from the experience of many deep borings which he made in the summer of 1926 in the Julianehaab district it was obvious that ice was quite absent from the ground.

[1] NATURE, **132**, 313 (1933).
[2] Oxford Univ. D.Phil. Dissert. 1935 (Abstract published at the Clarendon Press).
[3] cf. Rosenvinge, *Medd. om Grønl.*, **15**, 135 (1896).
[4] Polunin, *J. Ecol.*, **24**, 2 (1936).
[5] *Kgl. Danske Vidensk. Selsk. Biol. Medd.*, **6**, (3), 17 (1926).
[6] *Medd. om Grønl.*, **92**, (1), 57 (1932).
[7] Trapnell, *J. Ecol.*, **21**, (2), 311 (1933).
[8] cf. Rosenvinge, *Medd. om Grønl.*, **15**, 135 (1896).
[9] Nørlund, *Medd. om Grønl.*, **67**, 237 (1924).
[10] cf. Nansen, *Avh. utgitt av Det Norske Vidensk.-Akad. i Oslo*, nr. 3 (1926).
[11] Iversen, *Medd. fra Dansk Geol. Forening*, **8**, 4 (1934).
[12] cf. Jónsson, "Greenland", **2**, 333 (1928).

The Cyclol Hypothesis and the 'Globular' Proteins

DR. D. M. WRINCH has extended the cyclol theory of protein structure to account for the existence of space-enclosing or 'globular' molecules (*Proc. Roy. Soc.*, A, **161**, 505; 1937).

The cyclol theory showed that a molecular fabric could be formed on the basis of the polypeptide theory by assuming that the peptides did not lie fully extended but underwent rotation at the bonds to form hexagonal structures. A series of these containing 2, 6, 18 . . . $18 + 24n$ residues can form closed systems of regular geometrical form with three-way symmetry. The second member of this series, called 'cyclol 6', forms the basis of the 'cyclol fabric'. Other members of the series could, if it were desired, be used as the basis of geometrically regular two-dimensional fabrics.

Any theory of the structure of three-dimensional molecules containing several thousand atoms must take into account the mathematical possibilities of distributing these in space in such a way that the resulting model will account for the known chemical and physical properties of the substance in question. The cyclol fabric can be folded along certain well-defined lines to form space-enclosing models of regular geometrical form, without violating any of the fundamental requirements of the cyclol fabric; for example, truncated tetrahedra can be formed by bending round the cyclol fabric without any distortion of the cyclol net. The truncated tetrahedra form a series which contain 72, 288 . . . $72n^2$ residues. These tetrahedral models, like the original 'cyclol 6', allow for polymerization, so that one, two or more of them can be brought together by apposition of their plane faces to form a series of polymers.

The model containing 288 residues is of great interest for it would have a molecular weight approximating to 35,000, which Svedberg has found as a basic number for the molecular weights of globular proteins. For example, insulin and egg albumin (which on the cyclol theory consist of 288 residues per molecule) have molecular weights of approximately 35,000, while various other proteins have molecular

weights approximating to 35,000 × 1, 2, 4 or 8. Many of these under conditions of varying *p*H can break up reversibly into segments which are simple submultiples of the original molecular weight. It is also interesting to notice that Bergmann and Niemann (since the above prediction) state that the chemical analysis of egg albumin enables them to deduce that this molecule consists of exactly 288 residues (*J. Biol. Chem.*, 118, 301; 1937).

A series of models based on the truncated tetrahedron formed from the cyclol fabric and simple polymers of this, thus accounts satisfactorily for the type of molecular weight series found in some 'globular' proteins, namely, simple multiples of a basic unit of 35,000.

The Problem of Leisure

WE have not infrequently insisted upon the problem of leisure as one of growing importance, and have emphasized the inevitable effects of the application of science to industrial processes—effects which have been put under the heading of 'technological unemployment'. As the machine lessens the volume of toil required from men and women, our social organization must be adapted to give the new services which will be demanded of it. Already the move towards a reduction in working hours is apparent and must bring with it a corresponding increase in the hours of leisure. How will that leisure be used?

The widespread interest in the possible answers to that question was shown on November 18 when more than two hundred bodies were represented at a conference arranged by the National Institute of Industrial Psychology and the British Institute of Adult Education. The problem of leisure was the problem which attracted that very large audience, and it was finally decided to set up a committee representative of bodies willing to co-operate in the carrying out of what might be called our first survey of leisure. It will consist in the first place of an investigation of the opportunities for leisure, for, clearly, any such survey will fail in its purpose if it neglect factors such as housing conditions, transport facilities, the extent to which poverty debars from participation in recreation, and other similar considerations.

The purpose of any report which may be drawn up as a result of the investigation will not be to interfere with or supplant the work of bodies already engaged in work affecting leisure activities, but to assist them.

The survey will be on broad lines and will recognize that, while many leisure pursuits require organization, resentment would arise from anything suggestive of coercion, patronage or intrusion on individual privacy.

The present suggestion is that the investigators should base their report upon a first-hand examination of the facts in certain districts which would be selected so far as possible as being typical of prevalent conditions. The following list of districts has been compiled as one where investigations would doubtless be most profitable: a town of varied districts where the factories, dwellings and recreational facilities are within easy reach of one another; a district where the workers' dwellings and their recreational facilities are distant from their work; a developing district where the conditions of work and leisure have been planned, but where the population has grown up without local civic conditions; a developing, but unplanned, district; a district where varied industries are scattered amid rural surroundings; and a popular holiday resort, with special reference to the increasing extension of the holiday season beyond the summer months. The increase of holidays with pay, the raising of the age of entry, and the lowering of the age of exit, from industry and the incidence of shift work are all factors which must be taken into consideration as the investigation proceeds. Duplication of effort will be avoided and investigators will be asked to distinguish carefully between the collection of fact, the collection of opinion and their own conclusions.

Science News a Century Ago

Anniversary Meeting of the Royal Society

AT the anniversary meeting of the Royal Society on November 30, 1837, the president, H.R.H. the Duke of Sussex, being prevented from attending by illness, his address was read by Francis Baily. In the report of the Council for the year, it was said: "The principal business of public interest which has occupied the attention of the Council relates to the extension of accurate magnetical and meteorological observations in different parts of the world.

"A communication having been made by Lieut. William Denison, of the Royal Engineers, of a proposal from General Mulcaster, Inspector-General of Fortifications, that the officers of engineers generally should be employed, under the direction of the Royal Society, in promoting the advancement of science, by carrying on connected series of observations relating to Natural History, Meteorology, Magnetism and other branches of physical science, and suggesting an application to Government for a grant of funds necessary for effecting so desirable an object; a Committee was appointed to consider the proposed measure, and of the means to carry into effect the recommendations contained in the letter of Baron Von Humboldt addressed in April last to the President. Conformably with the report the Council fixed on the ten following places, namely, Gibraltar, Corfu, Ceylon, Hobart Town, Jamaica, Barbados, Newfoundland, Toronto, Bagdad and the Cape of Good Hope as being the most eligible for carrying on magnetic observations . . . these places being permanent stations where officers of engineers and clerks are always to be found." A grant of £500 for instruments was afterwards obtained from the Government.

Award of Two Copley Medals

THE report of the Council also referred to the award of the various medals, two Copley Medals being awarded on this occasion, one to A. C. Becquerel and the other to J. F. Daniell. The award to Becquerel was "particularly for the production of crystals of Metallic Sulphurets and of Sulphur; by the long-continued action of electricity of very low tension. In the memoirs particularly referred to by the Council he has especially in view to explain, by the agency of electricity of very low tension, continued for an indefinite time, the occurrence of crystalised substances in mineral veins. By his work Mr.

Becquerel has thus opened up a new field for inquiry and discovery, in which he has himself gathered the first fruits, but which still offers to future labourers the prospect of an abundant harvest of knowledge as regards both the recomposition of crystalised bodies and also the processes which may have been employed by nature in the production of such bodies in the mineral kingdom."

Antoine César Becquerel was born on March 7, 1788 and died on January 18, 1878. After passing through the École Polytechnique, he served in the French army for a short time but soon quitted the service and devoted himself to scientific research. He was one of the founders of electro-chemistry. He was admitted a member of the Paris Academy of Sciences in 1829. Becquerel was appointed to the chair of physics in the Musée d'histoire naturelle in 1837 and this post he held until his death. He was succeeded in the chair first by his son Alexander Edmond Becquerel (1820–91), and then by his grandson Antoine-Henri Becquerel (1832–1908), the discoverer of radioactivity. A statue of Antoine César Becquerel was unveiled at his birthplace, Châtillon-sur-Loing (Loiret), in 1882.

Level of the Caspian Sea

In a letter written from Dorpat on December 1, 1837, to Alexander von Humboldt, Friedrich von Struve, the famous astronomer, referring to the geodetical operations carried out by the order of the Emperor of Russia to determine the level of the Caspian Sea, said, "Our travellers G. von Fuss, Sabler and Sawitsch happily completed their laborious task on the 23rd of October. I have just received the reports and a copy of the journals from the village of Tschernoi-Rynof, near the station of Kolpitschja (on the road from Kisljar to Astrachan) dispatched on the 31st of October (N.S.). The rapid progress of the operations made it impossible to keep up the calculations at the same pace. Our travellers, however, have gone through the whole and are able by a preliminary calculation to state at once the following result as very near the truth :—*that the Caspian Sea is really considerably lower than the Euxine : viz.*, 101·2 *Russian* = 94·9 *Paris feet.* This preliminary result is warranted to be correct within five feet" (*Athenæum*, Dec. 23, 1837).

University Events

Birmingham.—At a special meeting of the Court of Governors held on November 18 the pro-chancellor (Mr. Walter Barrow) presiding, the resignation of the vice-chancellor (Sir Charles Grant Robertson) was accepted, the resignation to take effect on September 30, 1938. The appointment of the vice-chancellor has hitherto been made by the Crown and no age limit was attached, but by an alteration of the statutes (in 1927), future appointments were to be made by the Court and an age limit of sixty-five years was fixed. The pro-chancellor explained that, on approaching this age, Sir Charles voluntarily placed the continuance of his appointment in the hands of the Council, who expressed the wish that he should remain in office until the completion of the new Central Hospital and Medical School, which owed so much to his vision and patient work. As it is expected that both buildings will be finished by next summer, Sir Charles desired that he should retire on Septe ber 30 next, when he would have reached the age sixty-nine years.

The Court then proceeded, for the first time, elect a new vice-chancellor, and the pro-chancell proposed, on behalf of the Council, the name of D Raymond E. Priestley, giving an outline of h remarkable achievements. The proposition w seconded by the vice-principal (Prof. J. G. Smit and warmly supported by Sir Gilbert Barling a (from personal knowledge) by Mr. J. H. Reynold Prof. M. L. Oliphant and Prof. Lees. The Cou unanimously elected Dr. Priestley.

After the meeting of the Court a portrait of S Charles Grant Robertson (by Mr. James Gunn), pr sented to the University by 225 subscribers, w unveiled in the Great Hall by the wife of the pr chancellor.

Earlier in the afternoon Mr. T. E. Harvey, M. (Combined Universities), had formally opened S Francis' Hall, a chapel given to the University b Mr. and Mrs. Edward Cadbury for the use of t undergraduates.

Cambridge.—A research studentship at Emmanu College will be awarded in July 1938. Preference w be given to Candidates who have already complet one but not more than two years of research. Th studentship has a maximum annual value of £150, awarded and normally held for two years, but ma be renewed for a third. The studentship is n tenable by a woman or by a member of the Universi of Cambridge. Further information can be obtain from the Master, Emmanuel College, Cambridge.

An appointment to a research studentship Christ's College will be made at the end of July 193 Candidates must be men who will have graduat before October 1, 1938, at some university other tha Cambridge, and who have not commenced residen in Cambridge at the time of election. The studen ship will be normally held for two years, but it ma be prolonged for a third year in exceptional circu stances. It is of annual value not exceeding £20 Further information can be obtained from the Mast Christ's College, Cambridge.

Leeds.—Dr. J. W. Orr, lecturer in experiment pathology, was elected to the post of reader. Dr. C is also assistant director of cancer research.

The following appointments have been mad Dr. H. G. Garland as clinical lecturer in medici and honorary demonstrator in medical patholog Dr. J. A. Price as honorary demonstrator in medicin N. Lissimore as honorary demonstrator in patholog F. R. W. Hemsley and I. J. Keidan as honora demonstrators in anatomy ; Miss Florence O. B as research assistant in textile physics.

London.—Prof. A. J. Allmand has been appoint as from August 1, 1938, to the Daniell chair chemistry tenable at King's College. Since 1919 has held the University chair of chemistry at th College.

The following have been appointed Universi readers : Dr. L. P. Garrod (St. Bartholomew Hospital Medical College) in bacteriology ; Dr. C. Goodeve (University College) in chemistry ; C. W Dannatt (Imperial College—Royal School of Min in metallurgy ; Dr. H. J. T. Ellingham (Imper College of Science and Technology) in physic chemistry.

Societies and Academies

Paris

Academy of Sciences, October 11 (*C.R.*, 205, 585–632).

PIERRE LEJAY : The absorption of solar radiation by the atmosphere in band *A*. From a discussion of the results obtained from the study of more than two hundred spectra taken over a period of two years, it is concluded that the oxygen band *A* is entirely of telluric origin. The view of W. H. J. Childs that the effective width of a line is proportional to the square root of the atmospheric mass is not supported by these observations.

LUCIEN DANIEL : Heredity in the descendants of *Helianthus Dangeardi*.

J. G. VAN DER CORPUT : A new generalization of the Goldbach-Vinogradow theorem.

JEAN DIEUDONNÉ : Continuous numerical functions defined in a product of two compact spaces.

HENRI CARTAN : The theory of filters.

ANTOINE APPERT : The effective definition of nearly isometric measurements and on the generalized limit of M. Banach.

CARLOS BIGGERI : The singularities of Laplace integrals.

ROBERT SILBER : The idea of traction and of the yield of the propelling screw and on the deviations existing between the internal and effective characteristics.

V. DOLEJŠEK and M. TAYERLE : A focusing effect for X-rays by means of a crystal with variable incurvation.

MAURICE PARODI : The characteristic frequencies of chlorates, bromates and iodates. A comparison of the Raman and infra-red spectra gives data for deciding between the plane or pyramidal structure of the group XO_3. The latter appears to agree better with the experimental facts.

RAYMOND DELABY, LÉON PIAUX and ANDRÉ GUILLEMONAT : The application of the Raman effect to the study of some cases of allyl-propenylic isomerism.

ADREIN PERRET : Researches on the anhydrous cyamides and cyanamides of iron, cobalt and nickel.

JEAN ALBERT GAUTIER : The hydrogenation of some nitrogen substituted α-pyridones by means of Raney nickel.

MLLE. Y. BOISSE DE BLACK : An outcrop of Cantal basalt subsequent to a glaciation of the valley.

E. SAURIN : The presence of the fossil-bearing Norian on the coast of South Annam.

GÉRARD WATERLOT and EDOUARD ROCH : The Gothlandian of the Haut-Atlas to the east of Marrakech.

FRANZ BAERTS and ROMAIN VANDEWIJER : The alkalinity of the ash and loss of chlorine on incineration. Experiments on the loss of chlorine with corresponding formation of potassium carbonate when solutions of sugar containing potassium chloride are incinerated.

ANDRÉ GORIS : A tear-producing principle in the roots of *Ranunculus Thora*.

PAUL MATHIAS : The evolutionary cycle of a trematode of the family Allocreadiidæ (*Allocreadium augusticolle*).

HENRY SCHWAB : Changes in the hyperglycæmic action of adrenalin by the addition of zinc salts. The hyperglycæmia caused by adrenalin is increased and its duration increased when zinc chloride is simultaneously injected with the adrenalin. Similar effects have been previously noted for insulin and it is concluded that the effects in both cases are due to a modification of the cellular substratum, probably a change in the colloidal structure.

ANDRÉ LWOFF and HISATAKE DUSI : Pyrimidine and thiazol, factors of growth for the flagellate *Polytomella cæca*.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 469–533, Sept. 15).

R. F. KIMBALL : Inheritance of sex at endomixis in *Paramecium aurelia*. The race found by Sonneborn to have sexes I and II was used. As found by Sonneborn for conjugation, sex is segregated at the first fission after the formation of the anlagen (the portions of micro-nuclei which will form the new mega-nuclei at endomixis). Sex ratios of 1 : 1, 1 : 2 and 2 : 1 were found.

L. C. DUNN : A third lethal in the *T* (brachy) series in the house mouse.

E. HADORN : An accelerating effect of normal "ring-glands" on puparium formation in lethal larvæ of *Drosophila melanogaster*. In the mutation "lethal giant", no pupæ are produced ; puparium formation occurs, but at a later period than in the normal individual. Injection of "ring-gland", a small body located dorsally between the two hemispheres of the "brain", accelerates puparium formation, suggesting that this gland produces a pupation hormone.

B. P. KAUFMANN and M. DEMEREC : Frequency of induced breaks in chromosomes of *Drosophila melanogaster*. Cytological analysis of salivary gland nuclei shows that breaks occur with equal frequency in the *Y*-chromosomes, which are genetically inert, and in the autosomes, which are genetically active, suggesting that the structure of the chromonema is similar in all regions of the chromosomes.

F. D. MURNAGHAN : The direct product of irreducible representations of the symmetric group.

W. E. SEWELL : Degree of approximation by polynomials—problem α.

G. A. MILLER : Sets of independent generators of a finite group.

D. H. HYERS : On functional equations in linear topological spaces.

W. J. ROBBINS and F. KAVANAGH : Intermediates of vitamin B_1 and growth of Phycomyces. The thiazole and pyrimidine components of the vitamin appear to be utilized in molecularly equivalent quantities when offered as mixtures of varying proportions. This suggests that Phycomyces requires vitamin B_1 and synthesizes it from the intermediates.

P. W. WILSON and E. B. FRED : Mechanism of symbiotic nitrogen fixation. (2) The pO_2 function. Experiments in which the partial pressure of oxygen was varied lead to the view that molecular oxygen is not directly concerned in symbiotic nitrogen fixation. Indirectly it is important for its influence on the carbohydrate metabolism.

A. H. HOLWAY and W. J. CROZIER : The law for minimal discrimination of intensities (2). Experiments in which area of application on the skin is varied in extent and mechanical pressure is kept constant, support the findings with visual and auditory stimuli that least discriminable difference of intensity decreases with increase of stimulus.

W. J. CROZIER, E. WOLF and GERTRUD ZERRAHN-WOLF : Specific constants for visual excitation. The mean critical illumination for response to flicker was measured as a function of flicker frequency for a number of teleost species. The results provide support for the theoretical objection to the practice of

averaging data from individuals not necessarily genetically alike as regards the property investigated.

J. G. HAMILTON: Rates of absorption of radio-sodium in normal human subjects. Radio-sodium was prepared by bombardment of ordinary sodium chloride with deuterons from the cyclotron. The radioactive salt was dissolved in water and given orally. The radioactivity of the hand was measured by a Geiger-Müller counter held in the hand, the hand and forearm being enclosed in a thick lead box to shield the counter from radiation from the body. Absorption of radio-sodium begins within a few minutes and is apparently completed in 3–10 hours in some subjects. The method offers a new means for the study of the metabolism of sodium and other elements.

S. F. COOK, K. G. SCOTT and P. ABELSON: Deposition of radio-phosphorus in tissues of growing chicks. Radio-phosphorus prepared from red phosphorus by the cyclotron was fed to growing chicks, which were killed at different periods after administration; the radioactivity of thirteen tissues was examined. The results were in general agreement with those of Hevesy and of the Italian workers under Segrè. Radio-phosphorus was found in all tissues examined, but particularly in the skeleton and musculature. Comparison of the activities at 4 days and 60 days after administration showed marked movement of radio-phosphorus from muscle and intestine to bone, bone marrow and brain. Spleen showed high content of radio-phosphorus at all times.

Forthcoming Events

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

Monday, November 29

UNIVERSITY OF LEEDS, at 5.15.—Prof. T. H. Pear: "The Place of Imagery in Mental Processes".*

ROYAL SOCIETY OF ARTS, at 8.—Prof. J. C. Drummond: "Historical Studies of English Diet and Nutrition" (Cantor Lectures).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—L. Christensen: "Recent Reconnaissance Flights in the Antarctic".

Tuesday, November 30

ROYAL SOCIETY, at 2.30.—Anniversary Meeting.
Sir William Bragg, P.R.S.: Presidential Address.

INSTITUTION OF CHEMICAL ENGINEERS (at the Geological Society, Burlington House, Piccadilly, W.1), at 6.—Prof. A. Freundlich: "Industrial Applications of Supersonic Vibrations".

Wednesday, December 1

INSTITUTE OF FUEL (at the Institution of Mechanical Engineers), at 7.—Joint meeting with Institution of Heating and Ventilating Engineers.

H. L. Pirie and I. Lubbock: "Fuels for Heating and Hot Water Supply".

Thursday, December 2

CHEMICAL SOCIETY, at 5.—Discussion on "The Influence of Structure on the Action of Parasiticidal Drugs" to be opened by Dr. T. A. Henry.

KING'S COLLEGE, LONDON, at 5.30.—Prof. J. Chadwick, F.R.S.: "The Artificial Transmutation of Matter" (succeeding lectures on December 7 and 8).*

Friday, December 3

ROYAL INSTITUTION, at 9.—Prof. Irvine Masson: "Iodine".

Appointments Vacant

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

RESEARCH CHEMIST for the Bone Research and Development Association, Ltd.—Prof. W. A. Bone, Imperial College of Science and Technology, London, S.W.7 (November 29).

SCIENTIFIC OFFICERS AND ASSISTANTS in the Explosives Directorate and the Ballistics Directorate of the Research Department, Woolwich—The Chief Superintendent (December 3).

CHEMISTS for the War Department Chemist—The Under-Secretary of State (C. 5), War Office, S.W.1 (December 6).

PHYSICIST in the Research Laboratories of the G.E.C., Ltd., Wembley—The Director.

VETERINARY RESEARCH OFFICERS in Kenya—The Director of Recruitment (Colonial Service), Colonial Office, 2 Richmond Terrace, S.W.1.

RESEARCH PHYSICIST to the Printing and Allied Trades Research Association, 10 Robin Hood Court, London, E.C.4—The Director of Research.

Official Publications Received

Great Britain and Ireland

Friends of the Hebrew University of Jerusalem. Annual Report, 1936–7. Pp. 20. (London: Friends of the Hebrew University of Jerusalem.) [311

Report of the Council of the Royal Institute of International Affairs, 1936–1937: Eighteenth Annual General Meeting of the Institute, November 2nd, 1937. Pp. 112. (London: Royal Institute of International Affairs.) [311

West of Scotland Agricultural College: Plant Husbandry Department. Research Bulletin No. 5: Boron in Agriculture. By Dr. R. W. G. Dennis and Dr. D. G. O'Brien. Pp. 98+14 plates. (Glasgow: West of Scotland Agricultural College.) [411

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