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The Future of the South African Protectorates

THE statement made by General Hertzog, Prime Minister of the Union of South Africa, on his return from attending the recent Imperial Conference in London, which dealt with the question of the transfer of administrative control of the South African native Protectorates to the Union (*The Times*, July 7), has raised a grave issue in the gravest possible manner. He accuses the British Government of a dilatoriness virtually amounting to bad faith, and in the event of further delay, foreshadows an appeal to the Crown, of which the consequences both to Great Britain and South Africa would be so incalculable, that he is not prepared to accept as final the British minister's reply to pressure for early transfer.

General Hertzog clearly intended a reply to certain opinions expressed in the House of Lords in the debate on Lord Noel Buxton's motion on June 9 (see NATURE, June 26, p. 1083). When he went on to speak of the Government's attitude as dictated by the ballot box, he descended to a mere piece of political invective, worthy neither of its author nor of South Africa's case.

It cannot be denied that South Africa has a case ; and the interests of the Protectorates afford strong, indeed almost overwhelming, argument in support of that case on geographical, economic and administrative grounds. The territories are, and must always be dependent economically upon the Union. They have no natural effective outlet except through the Union ; they are dependent upon it for the employment by which their labour makes up the deficiencies of their capacity to produce. On the side of the Union any serious disparity in administrative methods might at any moment aggravate difficulties in dealing with its own native question. Nor should it be overlooked that the Union has been generous in assistance to the Protectorates in a time of stress, although that assistance may have been granted under a misapprehension, for which General Hertzog himself is largely responsible.

Mr. Malcolm MacDonald, the Secretary of State for Dominion Affairs, showed in the House of Commons on July 9 that there had been a complete misunderstanding of the position. There had been no undertaking that transfer would be effected within any specified period. Once more he enunciated in terms the pledge, which was again repeated in the House on July 13, that no action would be taken without previous consultation of the inhabitants of the Protectorates, white and native, though he could not be brought to the point of a categorical statement that without consent there would be no action.

In delaying transfer, the British Government has displayed supreme wisdom. In the eyes of informed opinion—and in this matter the House of Lords is perhaps a better gauge of public feeling than the House of Commons, hence General Hertzog's aggrieved reference to its periodical pronouncements—the time is not yet ripe. For this the attitude of the Union Government on the native question is as much, if not even more responsible than the admitted reluctance of the Protectorate native populations to acquiesce in the change of administrative rule.

Since the passing of the South Africa Act of 1909, a great change in outlook has taken place in matters affecting the welfare and the administration of the affairs of backward peoples. At that time the anthropologist was urging the imperative necessity for scientific study of native institutions and beliefs as a basis for sympathetic administration

of native affairs. In South Africa the Government had embarked on a policy which seemed to hold out to the native an avenue of approach to a useful participation in citizenship and a share in the future development of the country through the organization of native councils. Great Britain, therefore, at that time felt justified in looking forward to a day when all the natives of South Africa might pass to South African control. Events in the political, economic and industrial history of the Commonwealth have falsified anticipation. The problem of the native population, which as a sociological question should be approached in the spirit of scientific and objective inquiry, has become an issue in party politics, while the trend of legislation, notwithstanding pledges to initiate a more liberal course of action when once the 'menace' of the native franchise was removed, has been to strengthen the colour bar and to emphasize the social and economic disability of the 'inferior' race, through the policy of segregation. It is not the least disquieting feature of the present situation that a certain section of advanced native opinion is strongly in favour of segregation and the complete separation of the two races in the interests of the native himself.

As a self-governing Dominion, it is South Africa's business to deal with her native problem as seems to her best. A white population outnumbered by the native in the proportion of four to one has need of provident statesmanship if it is to preserve its supremacy without crippling its powers of expansion. There is, however, in South Africa a growing section of opinion, in which the anthropological school of thought counts for much, that sees in the present policy of segregation as enforced by legislation, no way out for the native towards further development. In present conditions, it is true, some measure of training in various directions, educational and vocational, lies open to the native, though these conditions are perhaps less favourable than they were a generation ago. But there is little scope for the exercise of the native's powers and energy when once he is trained. For this *impasse*; the anthropologist would seek to substitute conditions such as a scientific and dispassionate survey of the situation would suggest. These, he is confident from his knowledge and experience, would, without turning the native into a black European, open the way to growth along lines congenial to native character and institutions, and yet would admit him to a share in the development of the country, to the advantage of white and native communities alike.

These matters, however, are for the Union of South Africa to decide; but the appearance within the Union of a body of opinion critical of the dominant policy is not without its lesson for the people of Britain. Under the Imperial Parliament, the policy of native administration has virtually ceased to be a political issue. In general, parties are now united in accepting the doctrine of 'trusteeship' as the principle of government of the backward peoples of the Empire; and that in appropriate circumstances, "the interests of the native shall be paramount", has been enunciated repeatedly as the decisive formula of British native administration. In the South African Protectorates under the administration of British officials, circumstances have brought about a system of control, which if not technically 'indirect rule', approaches that method of government in some near degree. Under that system, a process of acculturation has been taking place, which is producing a system of religious belief and social organization, that if neither entirely European nor wholly African, has something of each, and yet—and this is the important factor—is both congenial to the African temperament and affords, in the eyes of competent judges, a potentiality of further cultural development along progressive lines. What those lines should be, it is the opportunity and the obligation of scientific study to assist in determining in the light of the effects of the cultural impacts which are now taking place—in short, the function of the 'applied anthropology' for which the Royal Anthropological Institute has recently appointed a standing committee (see p. 145).

Apart from the question of the obligation imposed on the Imperial Government by its pledge to consult the inhabitants of the Protectorates before any action is taken in the matter of the transfer of their administration to the Union, the crux of the problem lies in the temper with which the people of the Union of South Africa attempt to solve the problem of their own native population. Unless this is such as to afford a reasonable guarantee that it will foster rather than frustrate the steps, slow and hesitant they may be, now being taken by the natives of the Protectorates towards a cultural development, which may truly be regarded as a progress in civilization, the British Government should see no alternative but to hold its hand.

Evolution of the Holarctic Fauna and Flora

Die Holarktis:
ein Beitrag zur diluvialen und alluvialen Geschichte der zirkumpolaren Faunen- und Florengebiete. Von W. F. Reinig. Pp. vii+124. (Jena: Gustav Fischer, 1937.) 7.50 gold marks.

ONE cannot fail to agree with the author's remark in the preface to this interesting book, that the rapid recent development of ecological science has served, to some extent, to obscure the intrinsic value of biogeographical studies, which often tend to be regarded as a mere branch of ecology. Actually, biogeography, or the study of the composition, origin and evolution of the living faunas and floras, represents a higher degree of synthetic biological knowledge than either ecology or faunistics (or floristics), on both of which it largely relies for its fundamental data. The book under review must be regarded, on the whole, as a very successful attempt to treat the problem of the Holarctic fauna and flora on broad biogeographical and evolutionary lines.

The indisputable fact that the greater portion of the territory of Holarctis was either covered by Quaternary ice, or experienced the climatic effects of glaciations, was apparently the reason which made the author restrict his analysis only to the later stages of Pliocene and to Pleistocene. This course certainly simplified the task very greatly; but it can scarcely be justified in the face of many distributional facts, which obviously have their origin in much earlier geological periods. The volume of reliable palæontological data on the distribution of life in the present Holarctic region during the Tertiary is very considerable, while geological data permit one to form some judgment with regard to the Tertiary climates, as well. The restriction of the field of study is, therefore, largely artificial, and makes the results less complete and convincing than they might have been.

The main thesis of the book, developed at considerable length and with abundant supporting evidence, is that the present distribution of Holarctic animals and plants can be explained on the basis of their evolution during, and under the influence of, repeated glaciations and of warmer interglacial periods. The maximum glaciation in the Eurasian continent forced the temperate preglacial forest flora and fauna to retreat to four main 'refuge areas', namely: (1) Mediterranean; (2) Armeno-Persian; (3) Central-Asian (consisting of three separate parts—Afghanistan, Tian-Shan and northern Mongolia); and (4) Eastern-Asian (including south-eastern China and Japan).

In North America, the flora and fauna of the same pre-glacial type retreated also into four refuge areas: (1) Atlantic, comprising Florida and adjoining lowlands; (2) Mexican (subtropical); (3) Pacific, extending along the southern Rockies; and (4) Alaskan. The subsequent retreat of glaciers resulted in re-invasion of more northern regions from the refuge areas, where in the meantime distinct races and even species were produced by isolation. This re-invasion was not simultaneous everywhere, since the maximum glaciation, according to the author, both commenced and ended in Europe and in North America earlier than in Asia. This accounts for the considerable European element in the present Siberian fauna, and for the great affinities of the latter with the American one. Certain elements were slower in the re-invasion, and some of them remained restricted to refuge areas and represent well-known examples of discontinuous distribution. Repetition of retreats and advances of animals and plants during successive glaciations served to complicate the resulting distribution still more, and some of the details cannot be elucidated as yet.

Of course, this is only a very brief and greatly simplified summary of the author's ideas, which are developed with a wealth of data. These ideas certainly appear sound and well documented, if not wholly new. It is, however, obviously inconsistent to disregard the influences to which the Holarctic fauna and flora must have been subjected from the more southern zones of the continents under study. The author attributes to glacial climates the power to drive animals and plants into what are now subtropical zones; but he appears to ignore a northward pressure of subtropical elements (or those derived from them) during the warmer inter-glacial periods. If the displacements of climatic zones are admitted, it is only logical to study all their implications, including the influence of southern faunas and floras on those of Holarctis. The author prefers to be one-sided in this respect, and goes so far as to state that the present Mediterranean and even the Eremian zone cannot be separated from the Holarctic because they partly served as refuge areas for Holarctic plants and animals during glaciations. Such a sweeping disregard of deep ecological, floristic and faunistic differences which exist between deserts and temperate forests will not be accepted by other biogeographers.

A similar disregard of ecology is apparent in many parts of the book, representing probably a reaction against undue preponderance of the ecological point of view in modern biogeography. As an example, it is sufficient to point out that the author uses the words 'steppe' and 'desert' almost as synonyms, and often speaks of "Steppen und Wüsten" as of a single biogeographical unit, while there is nothing but a superficial similarity between these two types of habitat, which are profoundly different in their distribution, climate, ecology and in their plant and animal population.

It would be easy to criticize various lesser points in the author's theories, but this would be scarcely fair, since the book is clearly a first and incomplete attempt to present a connected evolutionary history of the Holarctic fauna and flora. The author has certainly succeeded in conveying the idea of slow climatic changes causing movements of plants and animals, and resulting in complicated distributional patterns of the present day. For this alone the book must be regarded as an outstanding contribution to biogeography in the modern sense of the word, and is certain to lead to fruitful discussions and to stimulate new researches.

B. P. UVAROV.

Early Science in Cambridge

Early Science in Cambridge
By Dr. R. T. Gunther. Pp. xii + 513 + 68 plates. (Oxford : The Author, The Old Ashmolean, 1937.) 42*s*. net.

A GOOD many years have passed since Dr. R. T. Gunther began to discover at Oxford the great store of old astronomical, mathematical, and other scientific instruments which enabled him to illustrate the development of scientific studies in that University from their earliest beginnings ; discoveries that have resulted in the preservation of much valuable material, which might easily have been lost, in the admirable Museum of the History of Science which he has arranged in the Old Ashmolean building.

Having thoroughly explored the resources of Oxford, it was natural that Dr. Gunther should turn his attention to Cambridge. There he found that while the existence of interesting objects was known to a few, no one had made a systematic examination of the ground. When, therefore, he expressed a desire to undertake this work, his suggestion was welcomed, and all necessary facilities were afforded him by those in a position to give him help. It was further arranged that an exhibition of the results of his labours should be set out in the Old Schools and be on view at the end of the Easter term, 1936. Dr. Gunther threw himself into this task with characteristic energy, and the results far exceeded all expectations.

From dusty cupboards in laboratories, from the corners of college libraries, and from seldom-opened museum drawers, he brought together a wealth of old apparatus which surprised even those who had some knowledge of the hidden treasures of Cambridge, and aroused great interest in numerous visitors during the all too short time the exhibition was open.

The historical and biographical notes which Dr. Gunther accumulated in the course of his researches, and the catalogue of the exhibition which he compiled form the basis of this book, which to do it justice must be regarded more as a source book than as an orderly treatise.

In his introductory chapter, Dr. Gunther wisely deprecates unprofitable controversy as to the relative age of our two ancient universities, and leaves their origins wrapped in the mists of antiquity, but by interesting quotations from William Harrison (1577), and other early writers, he shows the convenience and importance of the site of Cambridge at the head of a navigable water-way by which commodities could be brought to the town when roads were but miry tracks. The paragraphs headed "Roads and Communications", "Travel by Air", and "Railways", contain information which will be new to most Cambridge residents to-day, and the clauses relating to Cambridge in the Assessing Act for the Eastern Counties Railway, printed *in extenso*, give an amusing account of the obstacles placed by the University in the 'forties in the way of any of its younger members who wished to travel by train. A brief account of Fen drainage schemes and notable floods has especial interest in view of recent experiences.

The second chapter, entitled "Mensuration", is essentially an excerpt from the exhibition catalogue, prefaced by some historical matter relating to Sturbridge Fair and to the University in its capacity as an inspector of weights and measures.

Dr. Gunther deals next with mathematicians and mathematical instruments, and following the method he employs throughout the rest of his book, gives in chronological order brief biographical sketches of the eminent men who have cultivated this study in Cambridge, incidentally rescuing from oblivion many lesser lights. Thus, while Newton holds the field, Briggs, Oughtred, Seth Ward, Barrow and others are not forgotten, and the chapter is illustrated with excellent plates of the splendid set of mathematical instruments made for Roger North and now in the possession of Jesus College, and of the perfect specimen of Oughtred's circular slide rule which came to light in the Cavendish Laboratory.

Mechanics and physics are dealt with in the same way, the great wealth of material being handled under such sub-headings as weighing the earth, sound, heat, light and colour, magnetism and electricity.

A long and richly illustrated chapter is devoted to astronomy, and as is but natural, much space is allotted to astrolabes and sun-dials. It may, however, be doubted whether the importance of Dr. Dee justifies the amount of attention given to him.

Two short chapters dealing with geography and meteorology bring us to chemistry. Here the somewhat elusive figure of Vigani, the first professor of chemistry, comes to life with his cabinet of materia medica still preserved at Queens' College, and the better known names of Smithson Tennant and Wollaston receive adequate attention.

Chemistry leads on to medicine, and while "pestilence walks at noon day", a strange assortment of practitioners and quacks passes across the stage. This chapter is packed with curious lore, and leaves the reader with a wholesome respect for the stamina of those of our ancestors who managed to survive the attentions of their medical attendants.

Anatomy, physiology and pathology are dealt with next, and on almost every page will be found the record of some curious fact or the revelation of some quaint personality. Particularly interesting are the accounts of the researches of Glisson and Stephen Hales.

In the account of zoology, John Ray and his friend Willughby hold pride of place. Two of Ray's letters are reproduced in facsimile, and a number of others now published for the first time are to be found in an appendix. Ray, too, is prominent in the section devoted to botany, and Stephen Hales tells the story of some of his most important botanical discoveries in his own words.

The study of geology in Cambridge, being based on the foundation of Dr. Woodward, it is interesting to have before us his will *in extenso*. It can only be regretted that the annual inspection of his collections, to be followed by a dinner, to which he attached so much importance, has been allowed to fall into abeyance.

The appendixes with which this work concludes are not the least valuable part of it, and Sir Thomas Sclater's practice of fruit and fish culture towards the end of the eighteenth century will have interest for many.

Up till the middle of last century, it was still possible for one man to attain distinction in more than one branch of science. The arrangement of the matter of this book under subjects leads, therefore, to the appearance of the same individual in different categories and tends inevitably to a certain amount of repetition. This, with the intercalation of excerpts from the exhibition catalogue, produces a somewhat patchwork effect. The first inconvenience could scarcely be avoided, but if the catalogue had been printed as an appendix, the narrative would have become more continuous and satisfying.

In a work of this kind, some slips and misprints are bound to escape the vigilance of the author. Many have been noted, but not in undue number or likely for the most part to mislead a reader seriously. A few may be mentioned. Darwin worked at Downe, not Dover. Prof. G. H. F. Nuttall's name is unfortunately omitted from the list of the Quick professors, and the press set up in 1752, at which astronomical works were printed, had its home in Pembroke, and not, as might be inferred from p. 79, at Queens'.

Though the book suffers from a certain lack of orderly arrangement and from rather meagre documentation, a vast amount of interesting and entertaining information culled from a great variety of sources, many of them obscure, has been brought together within its covers. All Cambridge men should be grateful to Dr. Gunther for making it possible for them to become acquainted so pleasantly with the personalities, aims and achievements of their scientific forbears, and for compiling a work which should be in every college and departmental library. Senior members of the University who keep it handy on their shelves will find it a sort of scientific "Gunning", admirable for browsing in at odd moments; for most junior m mbers it will probably prove too expensive.

In conclusion, we would re-echo the hope expressed in the author's preface, that among the institutions of the University a modest room or two may be found, where the more interesting and important of the exhibits got together last year, suitably displayed and labelled, may find a permanent home. A. H.

The Structure of the Flower

Floral Morphology:
a New Outlook, with Special Reference to the Interpretation of the Gynæceum. By E. R. Saunders. Vol. 1. Pp. viii+132. (Cambridge: W. Heffer and Sons, Ltd., 1937.) 3*s*. 6*d*. net.

THE history of plant morphology shows a number of more or less distinct phases. The earliest phase was one of description, including the recognition of morphological categories and the introduction of terms. Later the idealistic concepts of Goethe laid the foundation of much that is still orthodox. With the advent of Darwinism, there commenced a long period of explanation in terms of use and, on the whole somewhat later, attempts to trace the evolution of organs. At the present time, all these earlier phases seem to be revived in a new interest in plant structure, with the introduction of certain new methods and theories.

The vast majority of existing seed plants are characterized by possessing flowers clearly marked off from the vegetative parts of the plant body. The evolutionary history of the flower is still obscure and, even as a preliminary to research on this problem, there is an urgent need for clarification in our knowledge of the morphology of its component parts. Botanists are not all agreed as to whether it be a simple stem bearing modified leaves, a modified branch system, or essentially a structure *sui generis*. All parts have been subject to detailed and comparative examination: perianth, androecium, and gynœcium (gynæceum). The composition of the latter has, however, been the subject of most recent research. The numerous papers of Miss E. R. Saunders have made botanists familiar with the theory of carpel polymorphism. None will deny the importance of her work in directing attention to the many peculiarities of arrangement, anatomy, and behaviour to be found in the ovaries and their associated parts in both monocotyledons and dicotyledons. In a first volume on floral morphology, Miss Saunders summarizes her views on the architecture of the flower, with special reference to the gynœcium, in an introduction, and outlines on this basis the flower structure of thirty-nine families. A student unacquainted with the new concepts would probably find the book somewhat difficult reading, partly because of the very few illustrative drawings. The size, founts, general format, and low price of the book are all excellent, and it is to be hoped it will be widely read and used, especially as a guide to laboratory work by teachers and students. If it gives stimulus to the detailed dissecting of flowers and a study of their anatomy in academic institutions, it will have fulfilled a most important and urgent need.

The special theory of carpel polymorphism, which is the central theme of the book, is "in accordance with the view that in true apocarpy the individual ovary is formed of a single carpel, which arises as a separate structure, but that in syncarpous and pseudo-apocarpous forms it is composed of two kinds of carpels, sterile and fertile". Two main types of carpels are distinguished: valve and consolidated. The former shows pinnate venation, marginal ovules (when fertile), and when present alone generally forms an apocarpous gynœcium. The consolidated carpel has a pair of strongly developed bundles close to the mid-line (with or without a median bundle). The ovules are usually borne on either side of the mid-line, and the consolidated carpel is, in syncarpous ovaries, generally fertile. It may be contracted (solid carpel) or expanded (pseudo-valve carpel).

Though based very largely on the number and relationship of the vascular strands in the flower, it is claimed that the principles outlined "dispose of many morphological fictions, including hypothetical splittings and unions, hypothetical suppressed whorls, 'commissural' stigmas, 'false' partitions, 'free central' placentation and epigyny, as traditionally interpreted, while 'parietal' and 'axile' placentation and 'septicidal' dehiscence now have an altered significance. They provide an explanation of obdiplostemony, various forms of fruit dehiscence, and many other hitherto unexplained features".

There is no doubt that, considering the evidence as a whole, Miss Saunders has presented a strong case. It is probable that not all her interpretations will be accepted by future investigators; but they will have to be examined from the point of view of the evidence she has provided, even if other viewpoints be also considered valid. The evidence is particularly strong in the *Rhœadales* (including the *Cruciferæ*) and in the *Liliaceæ*. Some of the families in which it is probably more difficult to provide an acceptable interpretation of the structure of the gynœcium on the basis of carpel polymorphism, such as the *Leguminosæ*, are not included in this volume. W. B. T.

Nauka Polska:
jej Potrzeby, Organizacja i Rozwój. (Science and Letters in Poland: their Needs, Organization and Progress.) Tom (Vol.) 22. Pp. ix+433. (Warszawa: Kasy Imienia Mianowskiego, 1937.)

VOL. 22 of "Nauka Polska", an annual publication edited by Prof. S. Michalski and issued by the Mianowski Institute for promoting Science and Letters in Poland, is devoted largely to a series of papers on the influence of science upon human culture and progress. Among several noteworthy contributions is one by Prof. S. Ossowski, who deals with the influence of the personal opinions of the man of science on researches in the domain of the social sciences. He goes on to examine the effect that personal political and social convictions can have upon the course of a research worker's investigations in such subjects as sociology, political economy and anthropology, that is, in sciences directly contributing to progress in social life.

The influence of physics upon the development of modern civilization is the theme of a contribution from Prof. S. Szczeniowski, who endeavours to show how the theories of pure physics and the exact sciences have moulded opinion with regard to modern conceptions of the universe. Another interesting memoir in this issue of "Nauka Polska" is that by Mme. Danilewicz, who wishes to direct attention to the scientific work conducted between 1805 and 1831 at the former lycée of Krzemieniec in south-east Poland (Volhynia). The concerted attempt of an enthusiastic group of specialists in physics, chemistry, mineralogy and botany to create a local interest in the flora and natural resources of this district made a most promising beginning, but was afterwards suppressed for political reasons.

In the notes referring to scientific events in Poland and abroad there is a brief account of the British Association meeting at Blackpool, and reference is also made to the activities of the Research Co-ordination Committee.

P E P (Political and Economic Planning)
Report on International Trade: a Survey of Problems affecting the Expansion of International Trade, with Proposals for the Development of British Commercial Policy and Export Mechanism. Pp. vii+302. (London: Political and Economic Planning, 1937.) Paper boards, 8*s*. 6*d*. net; cloth, 12*s*. 6*d*. net.

THE group of industrialists, distributors, local government officers, university teachers and others who have produced this comprehensive monograph claim allegiance to no political party and are concerned solely with the problems of social and economic reconstruction. It is a lengthy report and contains a mass of statistical and other matter, bearing on the mechanism, finance and politics of international trade. The writers conclude that the idea of sweeping away international trade barriers is impracticable and is being replaced by organized exchange between nations, which, however, should be more constructively planned. The report discusses at length such constructive measures by taking into account not merely economic needs but also politics, psychology, transfer difficulties and other relevant factors. Within the policy of the State there should be scope for the initiative of individual traders, especially in co-operative steps. International trade will probably become permanently a smaller proportion of total trade, and will certainly not return to past conditions; but on new and constructive lines there should be a measure of revival. Finally, it may be noted that the report examines frankly the role played in present trade by the economics of war.

Physiology in Health and Disease
By Prof. Carl J. Wiggers. Second edition, thoroughly revised. Pp. 1124. (London: Henry Kimpton, 1937.) 42*s*. net.

THE second edition of Prof. Wiggers' book follows the first after an interval of only two years. Special emphasis has been laid on subjects of clinical importance and the book is really a general text-book of clinical science. Chapters are devoted to such subjects as œdema, sleep, acidosis, peripheral vascular disorders, blood-pressure, valvular lesions, fever and diet. The section dealing with the circulation is particularly detailed.

The book covers much the same ground as Samson Wright's "Applied Physiology"; but it is about 35 per cent larger. No one man could speak with the authority of detailed knowledge over so wide a field, and the judgments of this book sometimes appear superficial. Its main value lies in the fact that it contains a very large number of references to original work and to detailed reviews. It should be useful to students and to those who seek access to literature dealing with subjects outside their own speciality. Prof. Wiggers is a physiologist, and his book will probably be more admired by physiologists than by clinicians.

The Physics of Electron Tubes
By Dr. L. R. Koller. (International Series in Physics.) Second edition. Pp. xvii+234. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 18*s*.

THE first (1933) edition of this book has already been favourably reviewed in NATURE (**133**, 968; 1934). The present second edition has been slightly enlarged, especially by the addition of short treatments of such topics as electron optics, secondary emission multipliers, "ignitrons" and positive ion emission.

The title of the book would be more appropriately "Introduction to the Physics of Electronic Devices", as it deals within its relatively short space not only with 'electron' tubes, that is, hard valves and photo-cells, but also includes gas-filled relays and even two chapters on photo-conductivity and photo-voltaic cells. The treatment is clear, bringing out the essential points. Intricate mathematics has been avoided by stating in such cases finished results; however, Richardson and Schottky's equation and the 3/2 power law have been derived in a special appendix.

Very useful for the beginner is a collection of problems (with solutions) and with the aid of a good list of references added to each chapter, he will be able to find his way to more detailed study of the subject.

A. B.

Ammonolatry: The Life Element*

By Prof. Henry E. Armstrong, F.R.S.

(*To a muted, musical undercurrent reminiscent of Aïda, in face of a moving, desert panorama with camels.*)

FOR several months, while I have been confined to my room, I have had before me two unusual and remarkable books which are of special interest to me, at a time when we have to admit that far more consideration must be given to the manner in which chemists are trained. The books are E. C. Franklin's "Nitrogen System of Compounds" and N. V. Sidgwick's "Organic Chemistry of Nitrogen", in both of which I have particular reason to be interested.

About thirty years ago, soon after the great San Francisco earthquake (1906), I visited Leland Stanford University at Palo Alto. The founder was doing penance: he had been tossed from his pedestal and was standing upside down, with his head through the stone pavement: I believe he was ultimately restored to righteousness without a feature injured. Chemistry was well on its feet. The professor, Edward Curtis Franklin, was at an early stage in the inquiry, now so associated with his name and school, into the properties of liquid ammonia in comparison with those of water, especially as an electrolytic solvent: though boiling at − 33·35°, it comes close to water in activity. Liquid ammonia was being brought into use at that time as a refrigerating agent, and Franklin had command of the technical product.

It may be mentioned here in parenthesis that Gore in his earlier work on the subject (1872–73) was forced to prepare the liquid separately for each experiment, by heating ammoniated calcium chloride in the tube containing the substance to be tested. He tested the solubility of more than five hundred substances. He had great difficulty in securing support for his work—in those prehistoric days it was considered to be of little interest. He made a similar study of liquid hydrogen fluoride, and all but isolated fluorine. Few are left to remember his persistent pioneering efforts in advocacy of pure research, for which he made a great personal sacrifice: unfortunately, he was not original. I had the privilege of being made his confidant and always regretted that he had so little encouragement. We were then near to the renaissance period, but so low was the ebb of curiosity that Frankland, Vernon Harcourt and others were suggesting that a list of subjects for research should be prepared. Actually the main cause of activity was not Kekulé's benzene formula but the discovery by Kolbe and others, after the 1870 war, that research work could be made of commercial value. The poor professor disappeared but academic training began to lose its value; now, after a second war, in Germany, freedom of thought is gone. She may have gained much commercially but she has sold her scientific soul. Our task is to make the same change impossible here: it is already set in, largely through the influence of commercialism.

Franklin's reason for entering on the inquiry is stated by him as follows:

"In the autumn of 1896, Hamilton P. Cady, then an undergraduate, was working at the regulation course in quantitative analysis. Observing after a time that the young man was becoming bored with the task, the writer, at the time giving instruction in analytical chemistry, proposed to him that he prepare several of the cobaltamine salts and confirm the composition of one or two of them by analysis. Some days later, with a beautifully crystallised specimen of one of these interesting salts in his hand, Cady stated that the ammonia in these and other salts containing ammonia must function in a manner very similar to that of water in salts with water of crystallisation. He suggested furthermore that liquid ammonia would probably be found to resemble water in its physical and chemical properties. As a direct consequence of Cady's suggestion has followed all the work done in this country on liquid ammonia."

Franklin died on February 13, 1937. We have to lament the loss of a colleague who could still regard chemistry as a practical subject but take notice of theory in general. His work on ammonia, already of no slight value, may some day rank high when the great problem of electrolytic conductivity is discussed with knowledge and without prejudice: as yet, it never has been. Franklin makes close comparison, compound by compound, of corresponding members of the oxygen and nitrogen systems. The ammonia work, however, is far from sufficiently described in his book. I had hoped the original papers would have been largely reproduced in readable form. If his friends were to provide a reprint it would be a pious act and a great boon to students. None the less, it is a most valuable conspectus.

Sidgwick's "Organic Chemistry of Nitrogen" is a book of very different type. Franklin would

* The proof of this article was corrected by Prof. Armstrong only a week before his death on July 13. The article represents, therefore, the final expression of the frank and critical views which he held upon the training of chemists and subjects of research. Whatever significance may be attached to these views, the fact that, while on his dying bed, he desired to make the two volumes mentioned in the article the subject of a contribution to NATURE, is a remarkable tribute to the active attention he gave to scientific subjects right unto the last. Prof. Sidgwick's book, to which Prof. Armstrong refers was reviewed in NATURE of July 3.—The Editor.

take us back to the worship of Jupiter Ammon, begun in the dry distillation of camel's dung. Sidgwick would have us 'resonate' to the latest doctrine of electro-valency. The first edition of his book was published in 1910 ; it was a positive thriller. Sidgwick gave me a copy, which I have always prized ; this has rested on a shelf near to my elbow and has often been taken down ; my hope that the new edition would have similar attraction is disappointed. Two Oxford fellows, T. W. J. Taylor and Wilson Baker, seem to have been mainly responsible for the new edition, but the names of a host of other helpers are given. Sidgwick only contributes seven pages of introduction and a page or two on *Chelate Orthonitrophenol derivatives*, which show that he is now devoted to the fashionable morganatic game of crab catching, an appropriate exercise for the Upper reaches of the Thames.

The plan remains what it was. The intention is said to have been to give an account of the simpler organic compounds and to discuss some of the interesting problems which these properties present, giving so far as possible adequate explanation of the necessary physical background. The authors have not the practical experience and critical judgment necessary to carry out their task in a way to make the book of practical value to students who would train to be chemists—of whom there are very few at Oxford. It is not a beginners' book and makes high demands upon previous knowledge, without explanation plunging the reader forthwith into technicalities known only to the specialist and impossible for the ordinary reader to understand. Though highly discursive and scrappy at times, necessarily a book written at such length contains much that is interesting, but no training in judicial method is to be gained from its use.

At least half of what is regarded as the most intellectual of our youth is attracted to the University of Oxford ; this element is all but absolutely classical in its outlook. Oxford needs medicine of a very different order from that represented in Sidgwick's book : medicine that will make it a school of practice in chemistry, not one of elocution. The University is receiving large funds but its traditions are such that it does not attempt to train men to be efficient and effective laboratory workers. It has grown up upon words and lives upon them. The Oxford way is to enforce knowledge of what is done as a preliminary to doing work—but you cannot learn a subject like chemistry without *doing* from the beginning and all the time. The book will suit Oxford youth able to memorize the purple patches and offer them up on the examination altar, hoping on leaving the Examination Schools to find an emissary of I.C.I. awaiting their return with the prized admission card to an assured haven of research. They, however, will have had little or no effective training in chemistry but only parrot instruction in structural formulæ.

In the first line of the brief introduction to the book the author at once plunges into the valency problem with full measure of 'noughts and crosses', mainly dealing with *Resonance*, blankly asserting that :

"The conception is the most important development which structural chemistry has had since it was extended to three dimensions by van 't Hoff in 1874. It is a result of the application of wave mechanics and could not have been deduced from classical dynamics ; but its essential conclusions can be stated very simply. If a molecule can have two or more different structures in the ordinary organic sense of the term, then under certain conditions its actual state is neither one nor the other but something intermediate between the two, which partakes to some extent of the properties of both but cannot be expressed in the usual structural symbols. The molecule is then said to exhibit resonance and to be a resonance-hybrid of the two or more structures.

This is a declaration which I hesitate to endorse. In his recently delivered presidential address to the Chemical Society (*J. Chem. Soc.*, April), our would-be trumpeter of nitrogen speaks with even greater modesty and exceptional clearness. We are there told that it was a product of the obscure doctrine of wave mechanism.

"The general conclusions of the theory of resonance are of great practical importance, especially to the organic chemist. But it is not to be expected that more than a very few organic chemists will have either the time or the ability to master these mathematical operations. It is therefore obviously our duty to express—or to induce the wave-mechanisians to express—the results in the simplest terms that are possible and this can really be done quite easily. The use of the technical language of wave mechanics for this purpose is quite unnecessary and in fact misleading, for it makes the non-mathematical reader think that as he can't understand the language he can't understand the conclusions either, which is quite untrue ; and not uncommonly, I think, it leads the non-mathematical writer to believe that if he knows the technical terms he must understand their meaning, which is by no means always the case."

I have known strange things said in chemistry but have never before been quite so stood upon my head.

Passing to the examples given, with carbon dioxide we have the three formulæ :

$$O=C=O \qquad O\overset{+}{=}C\rightarrow O \qquad O\leftarrow C\overset{+}{=}O$$

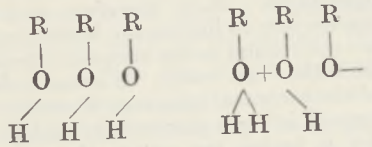
"According to the theory of resonance, since all these formulæ represent linear molecules and should have about the same stability or heat of formation, resonance must occur and the actual state of the molecule will be something intermediate between

them which we call a resonance hybrid, which will have a greater stability and heat of formation and a rather smaller distance between the atoms, than correspond to any one of the formulæ. Experiment shows that this is so. Further, since the last two formulæ are really the same, they must be represented to the same extent in the actual state of the hybrid, which therefore should be non-polar, as it is found to be."

According to this, resonance would seem to be a state of suspended animation in a molecular system with a shortened waist. Is not this "Much Ado about Nothing"? In what way it is an advance upon van 't Hoff is not clear. Kolbe was angered that van 't Hoff should introduce metaphysics into chemistry—what he would have said to Sidgwick passes expression. I am open to the retort, I know, that van 't Hoff was justified, but he had a solid model to build upon.

One of the more important applications of the conception of resonance is to the explanation of the power of hydrogen to serve as a bivalent link. There is no doubt, says Sidgwick, that a hydrogen atom is able to hold two oxygen atoms together. To me the evidence is entirely inadequate, nor is his present argument impressive.

"The crystallographers," he says, "have actually measured the length of this O-H O link (about 2·5 A) which they call the hydrogen link but the idea which formerly prevailed that this link, like co-ordinate links in general, was due to the hydrogen taking up two more shared electrons (so that it had four in all) is now known to be impossible, since a hydrogen atom cannot hold four electrons with sufficient firmness. The only alternative explanation is that we have resonance between the ordinary form and one in which there is an oxonium cation and an R-O anion:"



Truly a soul-saving set of symbols. Faint praise; scarcely hanging evidence. The nonchalance with which the inability to carry more electrons is treated and a new hypothesis at once found is amusing. Still better follows:

"The most extensive group of organic substances whose behaviour is determined by resonance is that of the aromatic compounds. It was recognised from the beginning that the two difficulties in the way of Kekulé's formula for benzene are, first, that we should expect two ortho di-derivatives; secondly, that benzene should have the reactivity of an ethylene derivative, whereas in fact it behaves almost always as a saturated compound. The conception of resonance removes both of these objections at once: the first because we assume the state of the ortho-compound to be permanently half-way between the two formulæ and the second on account of the increased stability which the resonance must produce. The last point can be determined experimentally from the heats of formation."

Such a statement cannot be taken seriously and it suggests insufficient historical and practical knowledge of the subject. I was one of the earliest workers with benzene, beginning in 1868. We never treated Kekulé's formulæ seriously—except for the purpose of registering the assumed disposal of substituent affinities: apart from the few who 'hammered' the idea for their own purposes, we thought of the two forms as present, if at all, in balanced proportions. The benzene symbol was used, not as a structural expression but as a convention in expressing interactions. We soon learnt that benzene had not the reactivity of an ethylene derivative. This led me to introduce the Centric formula.

The X-ray workers in course of time may help us out of our difficulty, but they are very slow. What are the forms of carbon: what of the form of that in benzene? The paraffins are the only hydrocarbons containing diamond carbon. We know scarcely anything of paraffinoids generally. Edgar's work with heptanes shows that isomerides differ greatly, presumably owing to shape and difficulty of packing. Rumour goes that a paraffin has been made which won't pack and therefore declines to solidify—too resonant, I suppose.

Benzene, we know, contains a second form of carbon, which I would call *ethenoid*. The centres of the atoms are in a plane, not zigzagged, the distance between them less than in diamond carbon. What is hexamethylene—benzene with six "electronic" pits filled in? It is little but a copy of benzene in appearance and properties.

During my lifetime the theory of valency has been developed from remarkably simple beginnings. When I began with Frankland in 1865, I heard his first course of lectures at the Royal College of Chemistry, published in his well-known book. He adopted Crum Brown's Graphite formulæ, behind which lay the tetrahedral conception. Carbon was a wooden ball with four holes in it. He had assimilated Kekulé's formulæ. I hold a paged proof of the later edition of his book in which he has written in all these. The original struggle between Kekulé and Frankland was over a fixed maximum of valency, that need not all be exercised but partly in abeyance. Kekulé as a joke copied Munchausen's method of shooting ducks on a ramrod.

Graphite is the puzzle—it seems to combine the two forms of carbon. This comes out very clearly in the model (Fig. 1).

The crystal is shown to consist of flat phenoid rings in parallel planes, 3–4 A. apart, more than double the distance between two atoms in the

plane ring. When oxidized, oxygen atoms seem to penetrate directly into the wide space between layers and this plane is porous to other agents also. I seem to see the atoms as a bird-like structure, with unequal wings, one paraffinoid about double the length of the other one : the other, the shorter, ethenoid as in benzene.

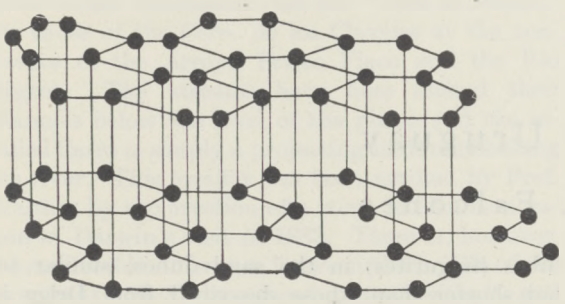
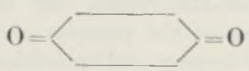


Fig. 1.
MODEL OF GRAPHITE. FROM *Chemistry and Industry*, AUG. 14, 1936.

Two forms of valency ultimately emerged—which acquired precision only when one was seen to be fixed by the *Electronic Charge* ; the other being that which Pickering and I termed *Residual* Affinity. I discussed this very fully in March 1886 in the *Proceedings of the Royal Society* in a paper on electrolytic conduction in relation to molecular composition, valency and the nature of chemical change. In the previous year (March 1885) I dealt fully with the conditions of chemical change, a subject entirely left out of account in modern times. Then in 1888 I discussed the origin of colour and formulated the explanation since known as the Quinonoid Hypothesis (*Chem. Soc. Proc.*, March 1888).

I postulated a triple unsymmetrical absorbing system, such as that in quinone.



I soon discarded mere material absorption and taking iodoform as type, assumed that the residual affinities of the iodine atoms came into play as absorbent centres.

$$\begin{array}{c}(CH_3)\\ I : I : I\\ I : I : I\\ (CH_3)\end{array}$$

In fact, I became dotty at an early stage in my career. I was specially fascinated at the time by fluorescent compounds and triphenyl methane derivatives. My colour hypothesis is applicable to all ethenoid properties, and what I set out to explain fifty years ago is little short of what Sidgwick would now explain. I doubt if there be much difference between us, but having read the classics early, I have always been held up by the caution :

> What's the use of Mercators
> Tropics, Zones and Equators.
> They are merely conventional signs.

Kekulé wrote an imperishable sign upon the fair face of our science when he introduced the simple hexagon. This expresses the one fact that is established—that six carbon atoms form a symmetrical complex, providing a convention which permits us to register and discuss isomerism in particular.

The colour of meta-compounds, I early asserted, was merely a case of the absorbent centres being in part formed between contiguous molecules—that is to say, extramolecular ; whilst in para- and ortho-quinones it is within the molecule, intramolecular.

Whatever resonance hybrids may be, do or suffer, they have little practical significance. To take up time in indoctrinating students at the university with such vagaries is not justifiable. At the moment we are in sorest need of chemists—it were time that the University Grants Committee or similar body intervened to secure rational, practical training for those few who will give serious attention to the several subjects to be studied.

Students have to be taught according to their dispositions. The biological type is very rare ; no greater perversion of the type exists than the ordinary biochemist, who is so-called because he works with material of living origin. The flag can be carried by very few. Mathematics beyond more than a very elementary stage is also without appeal to the chemist proper : the mathematician is a machine—prepared to let it be granted and act accordingly. The chemist should be inspired with feeling and only ask for truth and substance ; he should go straight to Nature. Of course, the majority who inflict themselves upon the natural sciences are just machines. The only teacher is experience.

The fact is, we forget how much that is taught as chemistry is mere convention. The hands-across, down-the-middle, business of "The Lancers". The "bridged-ring" is just Huck Finn, let-on stuff, yet the majority swallow it whole. Kekulé so demoralized chemists by his Ring that they have no hesitation even in giving it a handle, a bridge. Benzene must be a solid block of atoms—in so far as atoms made of electrons can be solid.

For a book on the chemistry of nitrogen, the most wonderful of all the elements in forming character—the determining element of life—to be of outstanding value, it must make manifest the sympathy which only long experience in the laboratory begets and inculcate habits of scientific

thought that will be of service to the student who desires to be a working chemist or to teach the subject in our schools. It is possible to reach the standard of knowledge required for a 'first' without acquiring these habits; this would not matter were it not that Firsts go into schools and stagnate. The failure of Firsts in the schools is the outstanding calamity of the costly attempt to introduce scientific training into education made during the past seventy years.

Chemistry at present is a sick man—"mostly conventional signs". Something less Snarkian is needed than "to measure the value of an idea in terms of incomprehensibility."

Darwin in Uruguay

By Dr. J. D. Falconer

H.M.S. *BEAGLE*, under the command of Capt. Fitzroy, sailed from Rio de Janeiro on July 5, 1832, for the Plata and anchored at Montevideo on July 26. For more than a year the ship was employed in surveying the extreme southern and eastern coasts of South America. The Plata was used as a base and to it from time to time the *Beagle* returned. Thus Charles Darwin, the naturalist aboard, had several opportunities of making closer acquaintance with the northern shores of the estuary and more particularly with the natural history and geology of the Banda Oriental, by which name the Republic of Uruguay, to the east of the Río Uruguay, was at that time known.

During the nineteenth century, Maldonado Bay at the mouth of the estuary was a favourite anchorage for ocean vessels. A strip of sand lined the margin of the bay and provided a playground for the men of the sea. In 1832 Darwin spent ten weeks at Maldonado and procured "a nearly perfect collection of the animals, birds, and reptiles" of the vicinity. He described Maldonado as "a most quiet, forlorn, little town: . . . separated from the river by a band of sand hillocks about a mile broad: it is surrounded on all other sides by an open slightly undulating country, covered by one uniform layer of fine green turf, on which countless herds of cattle, sheep, and horses graze. . . . The scenery is very uninteresting; there is scarcely a house, an enclosed piece of ground, or even a tree, to give it an air of cheerfulness"[1]. To this day Maldonado retains its secluded aspect, being overshadowed by the modern resort of Punta del Este on the eastern horn of the bay. The sands, however, are now grassed and treed over, the pastures fenced and decorated with plantations, rail and road communications developed and frequented, and the landscape dotted with houses and gardens and cultivated fields.

It was at Maldonado that Darwin's attention was directed to the occurrence of vitrified siliceous tubes (fulgurites) in the sand dunes, similar to, but shorter than, those described from Drigg in Cumberland in 1814[2]. These tubes, believed to be formed by lightning, are still found at Maldonado but less frequently than before, on account of the cover of vegetation.

Between Maldonado and Montevideo along the northern bank of the Plata, Darwin again remarked upon the absence of trees and the uninteresting character of the grassy plains, decorated only by occasional hummocks of granitic rock. He concluded somewhat hastily that in spite of abundant rain and a favourable climate "herbaceous plants, instead of trees, were created to occupy that wide area"[3]. However this may be, within the last hundred years there has been much successful afforestation, and along the shores of the estuary and in many parts of the interior the aspect of the country has been completely changed.

In November 1833, Darwin made an excursion into the south-western corner of Uruguay, from Montevideo to Colonia Sacrimiento, and thence to Mercedes on the Río Negro. By this time, after some experience of the pampas of Argentina, his opinions of the scenery and amenities of the Banda Oriental had undergone a change. He wrote: "I find that I look at this province with very different eyes, from what I did upon my first arrival. I recollect I then thought it singularly level; but now, after galloping over the Pampas, my only surprise is, what could have induced me ever to have called it level. The country is a series of undulations, in themselves perhaps not absolutely great, but as compared to the plains of St. Fe, real mountains. From these inequalities there is an abundance of rivulets, and the turf is green and luxuriant"[4].

On this expedition, Darwin visited the Arroyo de las Vivoras and Punta Gorda on the left bank of the Río Uruguay. From Mercedes he rode to the Sierra del Pedro Flaco, 20 miles up the Río Negro, and examined the natural sections in the

cliffs of Perika. He returned in a direct line across country to Montevideo, having been absent from the port for fourteen days. The *Beagle* sailed from the Plata for the last time on December 6, 1833.

Prof. Karl Walther, of Montevideo, has been at some pains to identify the exact spot on the bank of the Río Negro that Darwin visited, and he has come to the conclusion that the "cliffs of Perika" are those of the Cerro de los Claveles at the confluence of the Arroyo Perico Flaco and the Río Negro[5]. The streams have here incised their channels below the level of the plains and the so-called Cerro is simply a projecting bluff overlooking the river. This locality has been marked by Prof. Walther by the erection of a stone in commemoration of Darwin's visit in 1833. There is, however, a considerable difference between the height of the river-bank, 30–35 m. according to Walther[5], and that of the cliffs of Perika, about 50 ft. according to Darwin[6]: also in the composition of the lower part of the cliffs as recorded respectively by Walther and Darwin. It is thus permissible to doubt whether the actual section described by Darwin has yet been recognized. It is certain, however, that the river bank in this locality was Darwin's "farthest north" in Uruguay, and it was an admirable thought and a graceful tribute on the part of Prof. Walther to mark out a "Rincón Darwin" and to give the name of "Darwin Cliff" to the Cerro de los Claveles in recognition of "the importance of the geological observations initiated by the great British scientist"[5].

Some play has been made of recent years in local scientific circles over the alleged polemic between Darwin and D'Orbigny about the occurrence at Punta Gorda beneath well-defined Tertiary strata (Entrerriano) "in the vertical cliff, nearly on a level with the river" of "a bed of red mud absolutely like the Pampean deposit, with numerous often large concretions of perfectly characterized white, compact tosca-rock"[7]. D'Orbigny, who had preceded Darwin in South America and to whom Darwin was much indebted for examining and naming his molluscan fossils, had not seen the section at Punta Gorda during his sojourn in Uruguay and Argentina in the years 1826–29, but he had stated that he was unwilling to believe that beds of the same nature with the Pampean formation ever underlie the ancient marine Tertiary strata[8]. He maintained that there could be no analogy between the lower beds at Punta Gorda, which were of marine origin, and the Pampean clay, which was of quite a different character "déposée dans un laps de temps très-court, comme le résultat d'une grande commotion terrestre"[9]. Darwin steadily refused to accept this hypothesis and insisted that "from whatever source and through whatever means the great Pampean formation originated, we here have unequivocal evidence of a similar action at a period before that of the deposition of the marine Tertiary strata"[10].

The incident left an unpleasant flavour which has not yet been dispelled. Difficulties of investigation and comparison, of translation and re-translation, keep the controversy alive, while almost every author who visits the locality provides a different interpretation. Kraglievich of Buenos Aires, now deceased, who knew the red mud of Punta Gorda, said that "its nature is not entirely equal to that of the true Pampean of Argentina, . . . being much more similar to the clay and loessitic sandstone of Uruguay"[11]. Windhausen, also deceased, considered this sufficiently confirmative of Darwin's observation of a continental layer beneath the marine Tertiary beds[12]. Prof. Walther supports D'Orbigny, and represents Darwin as having fallen into error[5]. He admits that at first sight the character of the rock at Punta Gorda is "loessoid or similar to Pampean clay"[13], but asserts that there is a distinct petrographical difference between the two deposits. This has been investigated by Frengelli[14], who states that under the microscope the Punta Gorda clay is almost entirely composed of particles of volcanic glass with grains of sand scantily accessory, while in the Pampean clays the volcanic material is accessory to fine sand and silt. Thus it would appear that volcanic dust which falls on the pampas at the present day fell sometimes much more abundantly in the same region in past ages, and that there is accordingly every justification for Darwin's suggestion of the recurrence of similar conditions during the accumulation of the great Pampean formation.

While, therefore, it is clear that in respect of Punta Gorda, Darwin cannot reasonably be accused of any serious error of observation, those of us who know something of the country he traversed will readily agree with Prof. Walther in admiring the fact that, in a hurried journey of fourteen days, he was able to recognize certain details of geological structure the significance and importance of which are still being debated by lesser minds after the lapse of a hundred years.

[1] "Narrative", 3, 45, 46 (1839).
[2] *Geol. Trans.*, 2, 528 (1814).
[3] "Narrative", 3, 53 (1839).
[4] "Narrative", 3, 169 (1839).
[5] *Rev. Fac. Agr. Montevideo*, No. 8 (1933).
[6] "Geology", 3, 94 (1846).
[7] "Geology", 3, 92 (1846).
[8] "Geology", 3, 93 (1846).
[9] "Voyage", 27, 73 (1842).
[10] "Geology", 3, 94 (1846).
[11] *Rev. Soc. Am. Arq. Montevideo*, 2, 33 (1928).
[12] *Geología Argentina*, 2, 476 (1931).
[13] *Bol. I.G.P. Montevideo*, No. 13, 33 (1930).
[14] *Bol. I.G.P. Montevideo*, No. 12, 26 (1930).

Obituary Notices

Prof. H. E. Armstrong, F.R.S.

HENRY EDWARD ARMSTRONG, whose death on July 13 in his ninetieth year we regret to announce, was born on May 6, 1848, in Lewisham, where he lived all his life. Of the influences during his early youth which inclined him to chemistry, little is known, but when he left Colfe's Grammar School at Lewisham his father, acting on the advice of an engineering friend, allowed him to become a student at the Royal College of Chemistry, Oxford Street, in the summer term of 1865, actually Hofmann's last term before his departure for Berlin. Chemistry was the only subject taught, but the College was affiliated to the Royal School of Mines, then housed in Jermyn Street. A free lance, he attended such courses at the two institutions as he thought fit, including among them those given by Tyndall, Huxley and Ramsay, being also for some unexplained reason an almost regular attendant on Saturdays in the operating theatre of St. Bartholomew's Hospital. This roving quest came to an end when Frankland, who had followed Hofmann as professor and, towards the close of 1866, had been appointed with two other members a Royal Commission to inquire into the pollution of rivers in Great Britain, took him into the private laboratory, where together they developed the combustion *in vacuo* method of water analysis, which played so important a part in the campaign for ensuring the safety of the domestic water supplies of the country.

In October 1868, while yet young and impressionable, Armstrong went to Leipzig to work under Kolbe, an inspiring teacher, but remembered also as an unsparing and provocative critic. Graduating Ph.D. after five semesters, he returned to work with Matthiessen on alkaloids at St. Bartholomew's Hospital Medical School and, during the next twelve years, had charge of the chemistry classes for medical students preparing for the London degree; his appointment as professor of chemistry at the London Institution, Finsbury Square, followed a few months later. An earlier occupant of the chair had been Sir George Grove, inventor of the unpolarizable Grove cell and the hydrogen-oxygen gas battery: Armstrong's interest in the general problem of chemical interchange, and particularly of the part played by the depolarizer, can be dated from his discovery of specimens of the battery in the Institution's laboratory and the purchase of a copy of Grove's memoirs.

Armstrong's next appointment was that of professor of chemistry in the City and Guilds of London Institute for the Advancement of Technical Education, founded in 1878, but until the Finsbury Technical College was ready for occupation in 1883, the work of his department had to be carried on during four years in temporary quarters at the Cowper Street Schools, Finsbury. A year later he was translated to the newly erected City and Guilds College, South Kensington, where a novel type of institution came into being, self-governed academically by its four professors—chemistry, engineering, mathematics and physics—and independent of external examiners, which rapidly grew to be recognized as a great professional school of engineering. But in 1911, when the City and Guilds College by incorporation became the engineering section of the Imperial College of Science and Technology, its chemistry and mathematics departments were closed down, although provision was made for chemistry diploma students to finish their course under Armstrong's supervision—with its completion, chemistry ceased to be taught in the City and Guilds College, and the last of the laboratories of the department was dismantled in 1914.

The submergence of the chemistry department involved also the closing down of its crystallography laboratory, the only one in Britain, after an existence of rather more than a quarter of a century. Convinced that the most certain method of identifying a substance was to be found in its crystalline form, Armstrong in 1886 determined that, as an essential part of their training, diploma students in chemistry should measure any new crystalline substances they might prepare which were suitable for the purpose. To this end a course of laboratory instruction was arranged by Mr. H. A. (now Sir Henry) Miers, and under his direction and that of Pope and of Lowry who succeeded him, a wealth of material was accumulated, which led to the publication by Armstrong, conjointly with Colgate and Rodd, of a series of papers under the title "Morphological Studies of Benzene Derivatives" in the *Proceedings of the Royal Society* during 1910–14.

Thus ended an interesting and—if account be taken of the careers of students trained by its methods—a successful experiment in teaching chemistry on scientific, if unorthodox, lines. For Armstrong, such an ending was unrelieved tragedy. Thereafter, although a small suite of laboratories was placed at his service in the Royal College of Science building, it was no longer as an investigator but by controversy that his work as missionary for the propagation of the truth as he conceived it was carried on.

During the tenure of his chair at the London Institution, Armstrong maintained a steady output of research, but it was in an unexpected role that he first directed attention to himself. While working with medical students, but without previous training as a teacher, he—to use his own words—taught himself how to teach them chemistry and, aided by that effort, developed the system which became known as the heuristic method of teaching science experimentally in schools, in the advocacy of which, as opposed to the didactic method then followed, he never spared himself—or others—from the time he first championed the cause at the International

Conference on Education, convened in connexion with the Health Exhibition of 1884. In the paper submitted to the Conference, he outlined a constructive plan for training pupils "to observe and think and act with clearly defined purpose, the work being carried out with common materials and in relation to common phenomena". This scheme was elaborated in his contribution to the "Special Reports on Education" published by the Board of Education in 1888, and in the second report of the British Association Committee appointed in the same year "to inquire into and report on the methods of teaching chemistry in schools", whilst criticism of schoolmasters figured prominently in his addresses as president to the Chemical Society in 1894 and later to the Chemistry and Education Sections of the British Association. The heuristic method on the scale that Armstrong conceived it is dead: its fate could not be otherwise under an examination system —intensified since the widespread adoption of the School Certificate—which does not distinguish between the school and the academic outlook on science as a mental discipline.

Prior to the move to South Kensington, Armstrong had three major problems in chemistry continually in mind: the confusion about methods of determining constitution in the naphthalene series; the perplexing reactivities of camphor which served only to show the inadequacy of any formula for the substance based on the benzene model; and the mechanism of chemical change. Before his contribution to the elucidation of each is reviewed briefly, it should be mentioned that, as the College catered chiefly for engineers, the number of diploma students in chemistry was always small. Nevertheless, it was not long before the department as a school of research in organic chemistry attracted advanced workers from other institutions, doubtless in appreciation of Armstrong's pervading influence and a wise choice of members of his staff. He was constantly in the laboratory, his technical skill was always available when difficulties in manipulation arose, and his advice, encouragement, criticism and retentive memory never failed those who could benefit by them. If a measure of his stature as professor be desired, it may perhaps be gauged by the fact that, of those who worked under him as colleagues or pupils, not a few have achieved marked success in industry, whilst of the others six either hold or have held university chairs and seven became fellows of the Royal Society.

The naphthalene research, resumed in 1886, in which Davis, Rossiter, Lapworth and Wynne took part, was concerned with the bromination, nitration and sulphonation of the hydrocarbon and of its halogen and hydroxy derivatives and included a study of the mechanism of nitration; the investigation of many cases among sulphonic acids of the transference ('isomeric change') of the sulphonic group from one position to another within the molecule; and the preparation and identification of the complete number of di- and tri-chloronaphthalenes theoretically possible —ten and fourteen respectively—by reference to which the structure of any di- or tri-derivative of the hydrocarbon could be ascertained beyond doubt. Incidentally, it may be mentioned that Armstrong's series of papers embodying evidence for his view that carbon compounds exhibiting colour are quinone-like in structure belongs also to this period.

Towards the solution of the problem of the constitution of camphor from the analytical side, Armstrong and his collaborators made many important contributions. With Miller in the early 'eighties, he identified no fewer than four C_{10} homologues of benzene in the products of the action of sulphuric acid and other dehydrating agents on the substance. Then he and Kipping, who joined the staff in 1891, investigated 'camphren', an oxygenated product of the interaction with the acid—an inquiry which led Kipping jointly with Pope to discover how to sulphonate, rather than to dehydrate, camphor and to unravel the intricate isomerism of the camphor-sulphonic acids thus obtained. Important, too, was the identification of the three positions in which substitution occurs in the camphor molecule: this followed from the investigations of Kipping and Pope for the π-derivatives and of Armstrong and Lowry for the α- and β-derivatives. It was while studying the nitration of dibromocamphor at the College that Forster's interest in camphor chemistry was kindled and there, too, that Lowry's study of the mutarotation of nitrocamphor in various solvents proved that 'isomeric change' is not spontaneous but dependent on the presence of a catalyst.

Armstrong's unwavering advocacy of Faraday's view that "ordinary chemical actions . . . are themselves electrical" led him to define "chemical action as reversed electrolysis". The arguments by which this thesis was defended are to be found in the presidential addresses to the Chemistry Section of the British Association at Aberdeen in 1885 and Winnipeg in 1910; the presidential address to the Chemical Society in 1895; and in frequent contributions to ephemeral literature during the last half century. From first to last he never ceased to urge the view that solution is in effect a manifestation of chemical activity, the production of an electrolyte in aqueous solution being dependent on the combination of solvent and solute. Hence the prolonged controversy with Arrhenius (and Ostwald) whose theory of electrolytic dissociation in solution he regarded not only as unnecessary but erroneous—to be denounced with almost religious fervour as a chemical heresy. Although the Arrhenius conception has lent itself to modification, predicating among its later developments association of the *ions* of the solute with the solvent, and in its primitive form is now mainly of historical interest, the hydrate theory of solution has not emerged from the merely qualitative stage and involves too many unverifiable assumptions to make headway. Armstrong's experimental contribution to the discussion, in which Caldwell, Eyre, Worley and others assisted, is to be found in the thirty-two papers published during the period 1906–14 in the *Proceedings of the Royal Society* under the title "Processes Operative in Solution", the sixth of which gave, in 1908, the most complete statement of his theoretical views.

A few years earlier than, but parallel with, this inquiry into the nature of solution, Armstrong's interest in biological problems, never long in abeyance, led to an equally protracted study of the nature and mode of action of enzymes being undertaken under his guidance, about which, when it was begun, little exact information was available. In the first eight of the twenty-three papers, all of which save the first are to be found in the *Proceedings of the Royal Society*, E. F. Armstrong (Salters' Company's research fellow at the College, 1902–5) showed quantitatively that the action of sucroclastic enzymes as hydrolytic agents is controlled or retarded by the products to which they give rise and that from glucose by interaction with maltase, *iso*maltose, but with emulsin, maltose is synthesized. Later, the two Armstrongs with Horton isolated a β-glucase (prunase) both from the mixture of enzymes known as emulsin, and, more readily, from various species of *Prunus*, which was used by them to ascertain the distribution of cyanophoric glucosides in a variety of herbage plants and its variation with locality and season. Mention, too, must be made of the elder Armstrong's investigation of the activities of urease, linase and lipase—including the synthesis of fats by the aid of the last-named—carried out in conjunction with Caldwell, Eyre, Gosney and Horton among others which led to the conclusion that action takes place wholly at the surface of the colloidal particles of the enzyme in suspension—not between substances in solution—the enzyme having the double function of attracting the hydrolyte and of determining its hydrolysis. Not the least interesting of the series was a paper by the Armstrongs on the action of chloroform, toluene and similar substances in stimulating enzymic action in living structures which they suggest may lead to an understanding of the physiological function of the esters, terpenes and scents secreted by plants and of anæsthetics.

Of the many educational and agricultural bodies with which he was associated, two in particular gave Armstrong much pleasure: he was appointed a member of the Council of Almoners of Christ's Hospital in 1896 on the nomination of the Royal Society, and, after many years as deputy chairman of the Committee of Education, became its chairman in 1930, holding office until his health failed; and he represented the Chemical Society on the Lawes Agricultural Trust Committee at Rothamsted from its inception in 1889, becoming its vice-chairman in 1918 and its chairman so recently as last May. Frequently of late years in addresses and in articles from his pen, the national importance of pure (non-pasteurized) milk, natural foods and honest beer was urged as also the improvement of grass and other crops necessary for their production. His last public speech was made at a 'barley' meeting of farmers at Warminster in July 1936.

Fond of the open country and a frequent traveller abroad in middle life as Armstrong was, Borrowdale in spring and autumn became for many years his beloved holiday resort. Field geology was one of his hobbies: he was for many years a member of the Geologists' Association, and photographed the chalk from Yorkshire to Dorset to supply the illustrations for the monographs on this formation prepared by the late Dr. Rowe of Margate. Another was his garden, and in the unrivalled colours of flowers he found the utmost pleasure: the æsthetic side of his nature found its satisfaction, too, in other ways—he was an enthusiastic opera-goer and a discriminating lover of pictures. Let it be added that no account of his life would be complete without a tribute to the memory of his wife, whose serenity and comprehending sympathy during the fifty-eight years of their married life were to him boons ever gratefully acknowledged.

Armstrong was *doyen* of the Royal Society, having been elected to the fellowship in 1876; he had been a fellow of the Chemical Society since 1870, one of its honorary secretaries during eighteen years, and its president during two; LL.D. of St. Andrews; D.Sc. of Melbourne and Madrid; honorary liveryman of the Leathersellers' Company; Davy medallist of the Royal Society; Albert medallist of the Royal Society of Arts; Messel medallist of the Society of Chemical Industry; and Horace Brown medallist of the Institute of Brewing.

Temperamentally, Armstrong allowed feeling to influence his judgment to a degree unusual in an exponent of experimental science. Few of his speeches and writings were free from this intrusion: in his view, as expressed in the article "Chemistry" in the thirteenth edition of the "Encyclopaedia Britannica" (1926), "Chemistry however is an art as much as a science and the chemist is full of feeling which cannot be quantified". Essentially an individualist, he did not find it easy to co-operate with others even for causes that aroused his enthusiasm and, if "apostolic blows and knocks" were not forgotten in the advocacy of his views, an autobiographical note in a recent article (1932) is not without significance: " 'Somewhat arrogant and extreme perhaps in his denunciation'—the opinion passed by George Eliot on Savonarola in the proem to Romola—will probably be the criticism passed on me by my friends. The situation is saved by her remark 'But a *Frate predicatore*, who wanted to move the people, how could he be moderate?' " Nevertheless, those who knew only this side of Armstrong failed to recognize that these were but the defects of his qualities. Lacking his disinterestedness, his essential goodness of heart and his idealism, he could not have won and kept the good-humoured acceptance as an institution which became his in the post-War years. The attitude of mentor, the wounding criticism from a too facile pen: these need not be remembered now—rather we have to mourn the passing of a man whose devotion to chemistry, not least in its social implications, was the master passion of his life. W. P. W.

We regret to announce the following deaths:

Prof. Percy Gardner, emeritus professor of classical archæology in the University of Oxford, on July 17, aged ninety years.

The Marchese Marconi, on July 20, aged sixty-three years.

News and Views

Long Distance Air Record

THE Russian pilot, Colonel Michael Gromoff, with two companions, flying an Ant 25—1, landed at San Jacinto, California, on July 14—a flight estimated to be of about 6,625 miles from Moscow, over the North Pole which lasted 61 hours 7 minutes. The existing record of 5,675 miles, was held by the French airmen Codos and Rossi. The Soviet Government has been interested in this route, which follows practically a direct line across the North Pole. The pilot's log mentions the points Moscow, south-west Novaya Zemlya, North Pole, northern British Columbia, Oregon, San Francisco, and San Jacinto. So recently as last June, Chekaloff with two others on a similar machine flew over the same course, reaching Portland, Washington, a distance of 5,500 miles. The machine, also an Ant 25—1, was specially fitted for long-distance work, carrying extra fuel tanks and liquid oxygen, presumably for flying at considerable altitudes. The total loaded weight of the machine was 11½ tons, about 6 tons of which is stated to have been fuel for the flight.

ONE result of this flight, although possibly of a negative order, is the confirmation of the fact that the severe storms encountered, added to many hundreds of miles of ice-bound regions in which forced landings would be impossible, make it questionable as to whether such a route can ever be a commercial possibility, even though it may be the shortest distance from northern Europe to North America. Apart from this, such flights have an obvious interest to the Russian authorities, whose internal air transport and military defence problems over the long distances in northern Siberia, are of a very similar nature. Colonel Gromoff is a well-known Russian test pilot, who has been connected with the development of Russian aviation since about 1917. His name has been particularly associated with the principal Russian research station, the Moscow Central Aerodynamic Institute. It is interesting to remember that he broke a world record in 1934 with a continuous flight of 7,765 miles in a closed circuit.

Commercial Production of Oil from Coal

ON July 14, the House of Lords debated a Motion by Lord Mottistone that plant for obtaining oil from coal should be set up in Durham and South Wales in the interests both of national defence and increase of employment. Lord McGowan said that the experience of Imperial Chemical Industries, Ltd., has established the technical possibility of such processes but at capital and operating costs so high that the process, even with the assistance of existing protection, is not attractive to private capital. Success would have to depend not on private initiative, but on Government policy. The production of heavy oil for marine purposes from coal is at present uneconomical. The effect on employment ought not to be exaggerated. A plant capable of producing 150,000 tons of petrol annually provides work for 6,000 persons of whom 2,500 would be miners. Low-temperature carbonization and hydrogenation are complementary processes, and increased use of smokeless household fuels would promote both national security and national welfare. Hydrogenation processes, he emphasized, are a question of high national policy and beyond the purview of an ordinary limited liability company. Reference was made to the Fischer process and other methods of developing the use of coal. Lord Hutchinson, in reply, said the Government is awaiting the report of Lord Falmouth's Committee before deciding its policy for the production of oil from coal. Meanwhile, it is encouraging the establishment of plant for carbonizing coal at low temperatures, and another will be in production in South Wales next year.

Observations of the Longest Eclipse

INFORMATION has come to hand of the success of Prof. J. Q. Stewart, of Princeton University, and Mr. T. Stokley, director of the Planetarium in Philadelphia (representing the Franklin Institute and the Cook Observatory), in observing the recent total solar eclipse for an uninterrupted period of 7 min. 6 sec. from the S.S. *Steelmaker* of the Isthmian Steamship Co. The ship was at 133° 38′ W., 9° 49·5′ N. and the sun's altitude was 75°·8′. Owing to the ship's motion, totality lasted an extra four seconds for the observers. Prof. Stewart was engaged in visual study of the corona, while Mr. Stokley took photographs of the corona and measures of its total brightness at mid-eclipse. Preliminary measures show that this was of the same order as that of the full moon, while the observers on Canton Island have reported a value about half the full moon. The difference is in the opposite sense to what would be expected from purely geometrical considerations of the amount of low corona uncovered. The eclipse is described as a bright one. Despite the shadow extending around in all directions for seventy-seven miles, there was no need of flashlights to read the instruments, while ordinary newspaper print could be read with ease. Only Venus, Mercury and a few first magnitude stars could be seen, and there was indication of a high layer of haze in the sky. The corona was of late intermediate type, approaching maximum, made up of radial spikes and with no very long streamers.

Price Chair of International Economics

THE Council of the Royal Institute of International Affairs announces the appointment of Prof. Allan G. B. Fisher, of the University of Western Australia, to the newly established Price chair of international economics at Chatham House. The purposes of the chair is to provide the Institute with the means for

more intensive research into world economic problems than has hitherto been possible. Prof. Fisher is the first occupant of this chair, and will consequently inaugurate the new development in the Institute's activities which has been rendered possible by the recent generous gift of £20,000 made by Sir Henry Price for this specific purpose. Prof. Fisher, who was born at Christchurch, New Zealand, in 1895, has been professor of economics in the University of Western Australia since the beginning of 1936. He has contributed widely to periodicals dealing with economics, and has published two books, "Some Problems of Wages and their Regulation in Great Britain since 1918", and "The Clash of Progress and Security". Prof. Fisher hopes to take up his new post at Chatham House early in 1938.

Avebury

Two years ago, Mr. W. G. A. Ormsby-Gore, then First Commissioner of Works, urgently directed attention to the necessity of taking steps by means of a planning scheme to preserve the surroundings of Avebury, constituting in their entirety, as he pointed out, the most imposing monument of prehistoric civilization in the whole world. He then expressed the hope that it would not be long before such a scheme was initiated. There is now a prospect that this hope may be fulfilled. A scheme under the Town and Country Planning Act, 1932, has been prepared, which, if the necessary financial provision is made, will be put into operation before the main Wiltshire Planning Scheme, for the planning and preservation of the village of Avebury and its immediate surroundings. This scheme involves the prohibition of building in certain areas, and its restriction in others. The area covered by the prehistoric remains will be preserved for ever from building, and this, with the willing co-operation of the owner, also applies to the grounds and building of the Manor House, of which part dates from before 1548, part from the latter half of the sixteenth century. Over the main part of the downland, upon which the charm of the monuments and their appeal to the historic imagination so intimately depend, no new building will be allowed, except for agricultural purposes and necessary extensions of existing buildings, while the harmonious character of new cottages will be ensured and the planting of trees continued. To some small extent the village has encroached on the monument, but condemned cottages will not be re-erected. The agricultural character of the district will be preserved, and provision made for its future prosperity by the setting aside of adequate sites for new buildings.

This scheme will cost money. It is estimated that a sum of £11,000 will be required to meet the cost of compensation and other charges necessary to carry out the provisions of the scheme. Towards this, the sum of £4,000 already has been promised privately. An appeal for the balance is made by Sir Ernest Wills, Lord Lieutenant of Wiltshire, the Marquess of Bath, chairman of the County Council, Sir Philip Sassoon, First Commissioner of Works, Mr. W. G. A. Ormsby-Gore, Lord Baldwin and others. The National Trust has undertaken to receive subscriptions and hold the funds for the purpose of the Scheme, which will be controlled partly by a special body composed of representatives of the County Council, the Rural District Council, the Parish Council, H.M. Office of Works, the Council for the Preservation of Rural England, and the Wiltshire Archæological and Natural History Society, and partly by the National Trust. In view of the number of prehistoric monuments of the first importance in the neighbourhood of Avebury—Windmill Hill, Silbury Hill, Overton Hill, the Avenue, the Roman Road, to name the most prominent only—the price of preservation is small, and the appeal should meet with a ready response from the public.

Mesolithic Site in Surrey

AN important mesolithic site consisting of a group of pit-dwellings has been excavated by Dr. J. G. D. Clark near Farnham, Surrey. It was discovered by Mr. W. F. Rankine, a local archæologist, and has been described as "without any parallel in this country". (*The Times*, July 20.) The pits are circular and some three feet deep by about twelve feet across. One of the dwellings shows the site of a hearth, in which the blackening by fire can still be seen. Several hundred microlithic implements have been found, as well as a fine pointed-butt axe or pick, about five inches long. It is suggested that the settlement may be dated at about 3000 B.C., that is towards the close of the Mesolithic period, to which Dr. Clark in his studies of the Mesolithic period in Northern Europe has assigned a dating of from 8000 B.C. to 2500 B.C., when the full-fledged Neolithic culture takes its place. It would appear that this find gives an entirely new conception of the character of the mode of life of the Mesolithic peoples, which here at least would appear to have entered on a more or less settled stage. Other sites previously investigated afford little or no indications of permanent habitations, the inhabitants having lived in shelters, wind screens or skin tents as did the prehistoric inhabitants of North America and the less advanced of the recent Indians.

Necessities of Scientific Training

IN his presidential address delivered at Harrogate on July 6 to the Society of Chemical Industry, Lord Leverhulme emphasized the value of a scientific training whether a man's business career is on the technical side of industry or not. Scientific method and the scientific habit of thought have an application far beyond the confines of technical research and technical processes, and Lord Leverhulme referred in particular to the importance and value of a scientific study of markets involved in market research and forecasting, as well as to the development of scientific methods of management commencing with the ideas and methods of Taylor. Referring to the synthetic production of an increasing number of our raw materials, he suggested that this development indicates an economic revolution, the proximity and

scope of which are as yet insufficiently appreciated and that the time is not far distant when man, largely independent of the accident of geographical or climatic environment, will rely very considerably on the chemist to provide substitutes. The chemist is a brilliant example of the truth that scientific research leads through the elimination of waste to the conservation of resources. In an age of industrial research directed to the production of immediately practical results, the question arises whether, in the highly developed sciences, we have gone too far in the direction of intensive scientific research with the object of gaining immediate benefits at the expense of more general research in the less developed sciences which might ultimately yield social benefits of no less value, though more remote. Lord Leverhulme suggested that if the law of diminishing returns operates in scientific research, it might well be better to devote more of our resources to the less developed and less immediately profitable sciences.

Chemistry, Past and Present

IN Prof. G. G. Henderson's absence, owing to the death of Mrs. Henderson, his medallist's address at Harrogate on July 6 to the Society of Chemical Industry, "A Retrospect of Chemical Science," was read by his colleague at Glasgow, Dr. D. T. Gibson. Prof. Henderson, an original member of the Society, who in 1888 was responsible for organizing the first annual meeting in Glasgow, reviewed developments in chemistry in the last sixty years, including present-day tendencies, and in referring to post-War advances in applied chemistry in Great Britain, commented on the increasing demand for the services of chemists not only by chemical industries but also by many other industries, and on the marked appreciation of the importance of chemical research. In particular, he referred to the importance of the contribution of the chemical engineer in the development of chemical industries, as indicated by the provision of facilities for his training, and the foundation of the Institution of Chemical Engineers and of the Chemical Engineering Group of the Society. The future prosperity of Great Britain, Prof. Henderson urged, largely depends on the support given to the progress of science and especially of chemistry, and in this matter a united profession is of the utmost importance if its influence on public opinion or on Government departments is to be effective. For this reason, he pleaded for generous support of the Chemical Council and the scheme for a Chemistry House, and in particular urged that important firms employing considerable numbers of chemists should do more to encourage their staffs to become individual members of at least one of the publishing societies.

"Applied Anthropology"

IN view of the frequency with which, it is now generally recognized, problems of administration among backward peoples are intimately bound up with matters of belief and custom, and give rise to problems of which the many ramifications cannot be understood, or perhaps even perceived, without anthropological study, or upon which it may be necessary to seek the advice of the expert anthropologist, an announcement made by the Royal Anthropological Institute is both welcome and opportune. The Council of the Institute, it is stated, has appointed a Standing Committee on Applied Anthropology, which will meet at regular intervals for the discussion of problems of culture contact and the application of anthropological knowledge to the government of subject races. The Committee will seek to stimulate popular and official interest through the publications of the Institute, representations to Colonial Governments through the Colonial Office, and personal contacts with officials. It will also endeavour to further the organization and systematization of research in this field by means of discussion within the Committee and with experts engaged in research, and by promoting field-work according to a considered plan. A programme of typical questions affecting administration and upon which further research is desirable, has already been drawn up. In view of the wide connexions of the Institute and its close relations with those having expert knowledge in every part of the Empire, the work of the Committee cannot fail to be of the greatest utility in promoting a wise and enlightened policy in the administration of the affairs of the less-advanced races for whom the Imperial Government is responsible.

Need for the Study of Human Biology

IN an address at the celebrations of centenary of the University of Michigan on June 17, Prof. Raymond Pearl emphasized the necessity of evolving a science of human biology broad enough to synthesize our knowledge of man's mental and spiritual nature as well as of his physical nature if civilization is to survive. Our rapid advance in material things, while in wisdom and goodness little or no advance has been made, renders our development so lopsided as to threaten a catastrophe. The data for the unification of human knowledge do not yet exist, and one of the main challenges of the present situation to the man of science is that by natural aptitude and training he is the best equipped to obtain such data. Prof. Pearl believes that the universities, rather than specially founded independent institutions, offer the best environment for scientific research, and the achievements of the last hundred years encourage the belief that progress will continue.

The Bournemouth Outbreak of Typhoid Fever

THE report of the late Dr. Vernon Shaw, on his investigations into the outbreak of enteric or typhoid fever that occurred in Bournemouth, Poole and Christchurch in August and September 1936, has been issued by the Ministry of Health (Reps. on Pub. Health and Med. Subjects, No. 81. London: H.M. Stationery Office. 9*d*. net). The outbreak was first brought to the notice of the Ministry on August 21, 1936, and Dr. Shaw began his investigations the following day. He was informed that thirty cases of enteric fever had been notified during the preceding

twenty-four hours, and that a number of other patients, scattered throughout the three towns, were under observation. The only factor common to all the patients was the consumption of raw milk retailed by one distributor. It was concluded that the milk was infective for a period of about thirty-one days preceding August 22, and the approximate number of persons who contracted the disease was 718, of whom 518 were residents, and of these fifty-one died. No source of infection could be discovered among those distributing the milk, nor at the retailer's depot. The supply was collected from thirty-seven farms scattered throughout a large part of Dorset. Dr. Shaw was satisfied that the outbreak was due to the consumption of raw milk, and that the dealer's supply was infected by the contributions of one or possibly two producers whose milk in turn was infected by water from a contaminated stream. Immediately the outbreak was recognized, the distributor, acting on Dr. Shaw's advice, pasteurized the whole of his supply, and no unpasteurized milk was distributed after the morning round on August 22. This measure was immediately successful in terminating the outbreak.

Poetry and Astronomy

DR. F. W. GROVER, professor of electrical engineering, Union College, Schenectady, N.Y., has contributed to the *Scientific Monthly* of June an article in which are brought together a number of striking passages in poetry referring to astronomical objects and phenomena. Milton, Dante, Tennyson and Longfellow are naturally given the chief prominence in these extracts, but there are also beautiful passages from Browning, Housman and others. Dr. Grover refers appreciatively to Mr. Alfred Noyes's "Watchers of the Sky", but wonders why the new knowledge of the starry heavens makes so small an appeal to contemporary poets, whose fancies rarely stray into this virgin field. "Yet," he says, "it would be a fascinating task, and one demanding no mean ability, to picture the whirl of the spectroscopic binaries, and the rhythmic oscillation of the Cepheid variables, to describe the individualities of the giant and dwarf stars, or to soar in imagination to the confines of an expanding universe."

Progress in Gliding

RECENT numbers of the *Sailplane and Glider*, the official organ of the British Gliding Association, give evidence not only of the advances that have been made in the technique of motorless flight, but also of the scientific knowledge that it is producing. The development of aeroplanes has been so spectacular that development of sailplanes may be overlooked. But these have attained an airspeed of 87 m.p.h., a straight line distance of 313 miles and a height of more than 19,000 feet; records all beyond those of power planes in 1911. It has long been a reproach that sailplanes were dependent on hills and winds; but an effort was made last June to meet this by the organization of a cross-country circular tour. A definite route of 415 miles, beginning and ending at Darmstadt, was laid out, the time allowed being ten days and each separate flight was to start with an aeroplane tow to not more than 500 metres. Of the eight pilots who got away, four completed the course in the time, the first taking only seven days. The use of 'thermals'—ascending currents apart from clouds—has become more widespread. Of late, at four or five English gliding centres, pilots have been pulled up to a few hundred feet by a winch and have got away without any help from the wind or from a hill.

ON the scientific side, the practice of soaring inside clouds, as well as the use of thermal currents and of cold fronts, has given valuable meteorological knowledge. Soaring in clouds not infrequently proves adventurous. Last June, for example, a German pilot went into a cloud to gain height and his rate of ascent increased from 4 m. a second to beyond what his variometer would register. When he was at 16,400 feet he tried in vain to get out of the cloud; he was tossed up and down, thoroughly chilled and bombarded with hail; the climax came when a wing broke off. However, the pilot with difficulty got clear, and descended to safety in his parachute. Naturally those who take such risks want to learn all they can about the conditions; and while some carry special recording instruments, others work out the paths of air in thermals or make and study fast-motion cloud pictures. As an illustration of the data brought by such means may be quoted the records of pressure, temperature and humidity obtained during a flight from the Chiemsee across the Tyrolese Alps into Italy; the pilot rose to 10,800 feet to cross the Gross Venediger. Meteorologists doubtless have shrewd ideas as to what goes on in such places as cloud-cells and lenticular clouds; but there, as well as in many other regions, definite observations must have the highest possible value.

Monthly Meteorological Elements

IN the *Meteorological Magazine* of June there is a new feature that has been developed as a result of a proposal made by Prof. A. Wagner at the International Meteorological Conference at Copenhagen in 1929, that monthly mean values of various meteorological elements should be broadcast as soon as possible after the end of each month for selected meteorological stations. The arrangements for carrying out this proposal were completed and ratified at the Warsaw Conference in 1935, and provided for the inclusion in the broadcasts of mean pressure in millibars or millibars and tenths of a millibar, mean temperature in degrees and tenths, total rainfall in centimetres, and, for certain places, resultant air transport for the month. Since the first broadcasts were made in June 1936, the selected stations have increased in number, and data for Russia, Siberia and America are now included. The figures for May 1937, except those for air transport, have been discussed in the journal mentioned above, pressure and temperature being plotted so as to show cartographically the main features of those elements of the weather for that month over a large part of the northern

hemisphere. The interesting fact emerges that the excess of temperature above the average for 1901–30 in the British Isles, which ranged from 1° to 3° F., was also experienced throughout Europe and the greater part of North America, the excess being more than 5° F. over the north-east of Europe, most of Scandinavia and northern Canada and part at least of the Nile valley. The warmth of Europe and North America is seen to be associated with, if not due to, a lowering of mean pressure in the arctic regions and Siberia, combined with an excess of pressure over most of Europe, the United States and southern Canada. This information was available at the Meteorological Office within seven days of the conclusion of the month under review.

Wear of Motor-Car Engine Cylinders

THE problem of cylinder wear has now become very serious in commercial and public service vehicles, according to an article in the January issue of the *Nickel Bulletin*. This is due to the new designs giving higher efficiency, and also the use of aluminium pistons. Wear is considered to be due to a combination of two causes: mechanical abrasion and the corrosive attack of the cylinder walls by the products of combustion. The former predominates in vehicles running for long periods with a hot engine such as motor-buses used for long-distance runs in daily service. The latter effect is the more important for vehicles which run intermittently with long waits between runs, like delivery vehicles. In these the engines never get properly warm. The development of nickel cast iron has provided a satisfactory solution. The addition of one or two per cent of nickel to a suitable composition of base iron has produced cylinder castings which are readily machinable and yet have a high Brinell hardness. Recently the manufacturers of many commercial vehicles have obtained excellent results by using heavily alloyed iron. The cylinders of both petrol and Diesel vehicles are now being regularly made of irons containing 4–5 per cent of nickel with or without proportions of chromium and molybdenum. Improved machinability is obtained by slowly cooling the castings from a temperature of about 650° C. When this course is followed, the original hardness is restored after machining by air-cooling the material from a temperature of about 850° C. In France, this hard type of iron has been used for several years with satisfactory results for air-cooled motor-cycle cylinders.

International Union of Biological Sciences

PROF. M. J. SIRKS (Wageningen, Netherlands), secretary of the above Union, reports that the next General Assembly will probably be held in July 1940 at Stockholm immediately before the seventh International Botanical Congress. The president is Prof. E. D. Merrill (Harvard) and the vice-president, Prof. D. M. S. Watson (London). The report in NATURE (136, 612; 1935) on the International Botanical Congress at Amsterdam in September 1935 referred to the establishment of a liaison between the Congress and the Union. Dr. F. Verdoorn (Leyden), secretary of the Botanical Section of the Union, reports on the work of this Section, which was deputed to execute the resolutions passed by the Congress and to assist the various commissions and committees then appointed. He reports that an index of current plant science periodicals, prepared by the Commission for Documentation, will be issued during 1937, and that the Commission for Urgent Taxonomic Needs is preparing an "Index Herbariorum". Suggestions or questions bearing on botanical nomenclature should be sent to Dr. T. A. Sprague, Royal Botanic Gardens, Kew, secretary of the Commission of Nomenclature.

Scientific Annual Publications: New ASLIB List

A SIXTEEN-page booklet has been issued by the Association of Special Libraries and Information Bureaux as a supplement to the ASLIB Book List, containing classified particulars of 212 recommended annual publications of scientific and technical interest, published in the English language. The publications are arranged by subjects, and include representative U.S.A. publications as well as those of the League of Nations and many of H.M. Government reports, etc., which are not often found in Press guides. The list should be of considerable service to information officers and those in charge of reference libraries or intelligence departments. The List can be obtained from the Association of Special Libraries and Information Bureaux, 31 Museum Street, W.C.1, at a charge of 2*s*. per copy to subscribers to the ASLIB Book List and 3*s*. 6*d*. to non-subscribers.

International Congress of Anthropological Sciences

ARRANGEMENTS are now announced for the second International Congress of Anthropological and Ethnological Sciences to be held at Copenhagen on August 1–6, in accordance with the decision taken at the first congress in London in 1934. It will be under the patronage of H.M. the King of Denmark and Iceland. The Congress will meet in seven sections, covering respectively physical anthropology, psychology, demography, ethnology, ethnography in six sub-sections according to geographical areas, sociology and religion, and linguistics and writing. Arrangements have been made for exhibitions and demonstrations in connexion with the subjects to be discussed, among them anthropological material of the Eskimo and Scandinavians of Greenland in the Middle Ages, and from the prehistoric burials of Denmark, and the skulls of Lagoa Santa, Brazil. There will be a demonstration of the relation of the ancient dwellings of Denmark and the structural systems of prehistoric times, which will take place at the Lyngby Folk Museum, where there will also be an exhibition of Danish national dances, including those of the Faroe Islands. A collection will be on view of medieval Icelandic manuscripts referring to the discovery of Greenland and Vinland, as well as the manuscript of Pomo de Ayala on the Kingdom of the Incas and Peru, recently published by the Institut d'Ethnologie de Paris, and manuscripts of the Iranian Avesta. The Ethnographical Museum, which has been closed for several years for enlarge-

ment and is the oldest in Europe, having been founded in 1846, will be reopened to the public for the first time at the meeting of the Congress. At the close of the session, an excursion will be made through Denmark, on which visits will be paid to kitchen-middens, Megalithic tombs, tumuli of the bronze age, iron age fortifications, the new Viking ship recently discovered at Ladby, and other antiquities of the Middle Ages. Subscriptions (members 30 Danish crowns, associates 15 Kr.) may be addressed to the Treasurer of the Congress, Nationalmuseet, 10 Ny Vestergade, Copenhagen, K.

Seventeenth International Geological Congress

THE seventeenth International Geological Congress is being held in Moscow on July 20–30, as noted in NATURE of January 23, p. 143. Many tours for the delegates have been arranged ; for this purpose guide-books have been prepared giving detailed descriptions of the routes, all the interesting outcrops of mineral strata, the deposits of useful minerals, etc., with maps, plans and sectional drawings. Every delegate has a set of twenty-eight guide-books, and a newly issued geological map of the Soviet Union ; each tour is being conducted by a Soviet geologist. According to a report issued by the Soviet Union Year Book Press Service, 403 foreign delegates, representing forty-six different countries, are attending the Congress ; they include 139 from the United States, 50 from Great Britain, 33 from France, 20 from Japan and Manchukuo, 13 each from Germany and South Africa, and 11 from Sweden. Of Soviet geologists, 1,600 have intimated their desire to be present, but as many of them are at present engaged in field work, not all of them will be able to attend. The delegates will spend two days in Leningrad, where a session of the Congress will be held, and visits will be paid to the geological museums of the Mining Institute, the Central Institute of Scientific Research, the Arctic Institute, to give representatives of foreign countries an opportunity of becoming acquainted with the general characteristics of the mineral resources of the Soviet Union. In Moscow, the Congress will hold its sessions at the Observatory, where the institutes of the Academy of Sciences of the U.S.S.R. have also arranged an exhibition of collections relating to mineralogy, geochemistry and useful minerals, and the Palæontological Institute is showing its collection of Perm vertebrates of the North Dvina Gallery. Among the subjects coming up for discussion at the Congress are : problems of oil and world oil resources ; geology of coal deposits ; the Pre-Cambrian system and its useful minerals ; the Perm system and its stratigraphical arrangement ; the inter-connexion of tectonic processes, magmatic formations and ore deposits ; tectonic and geochemical problems of Asia ; deposits of rare elements ; geophysical methods in geology ; geology of the Arctic and Antarctic.

Beit Fellowships for Scientific Research

THE Trustees have awarded Beit fellowships for scientific research, tenable at the Imperial College of Science and Technology during the academic year 1937–38, as follows : extensions of fellowships already satisfactorily held for one year to Dr. N. Kemmer, for the continuation of his work on the theoretical studies in nuclear physics, under the direction of Prof. S. Chapman ; and to E. K. Woodford, for the continuation of his research in plant physiology, the work to be done under the supervision of Prof. F. G. Gregory ; new fellowships tenable for one year, but renewable for a second, to D. W. Goodall, for research on the physiology of the tomato plant, under the direction of Prof. F. G. Gregory ; H. A. C. McKay, for an investigation of chemical problems by the radioactive indicator method, under the direction of Prof. J. C. Philip ; A. K. Powell, for research on the various strains of *Heterodera Schachtii*, under the direction of Prof. J. W. Munro. The Trustees have also awarded a special Beit research scholarship to Dr. A. G. Gaydon, for research in spectroscopy under the direction of Prof. G. P. Thomson.

Announcements

GEHEIMRAT PROF. ERICH LEXER, professor of surgery in the University of Munich, and the chief representative of plastic surgery in Germany, has been awarded the Goethe Medal for art and science on the occasion of his seventieth birthday.

THE sixth International Montessori Congress will be held in Copenhagen under the auspices of the Danish Minister of Education on August 1–10. Dr. Maria Montessori will give an address entitled "Educate for Peace". Further information can be obtained from the General Director, International Montessori Association, 1 Hampstead Hill Gardens, London, N.W.3.

ACCORDING to official reports, the birth-rate in Soviet Russia is steadily increasing. Last January, the number of births registered was 21·7 per cent higher than in January 1936, and in the first quarter of this year it was about 30 per cent higher than in the corresponding quarter of 1936. Of the Union republics the Ukraine records the largest increase for the quarter, namely, 70 per cent.

THE University of Reading proposes to reprint, in type similar to that of the original and accompanied by wood-cuts of the original drawings, the "Observatories Anatomicæ Selectiores Amstelodamensium", 1667–73. This work, the record of the observations of the Amsterdam School on the anatomy of seven mammals, four birds, the tortoise, the frog and thirteen fishes, is rare and its contents not widely known among biologists. Prof. F. J. Cole, to whom subscriptions for copies (1 guinea each) should be sent, is contributing a critical introduction.

ERRATUM.—In the announcement in NATURE of July 17, p. 104, of the award of the Johannes Schmidt Medal to Mr. H. G. Maurice the words 'thirteenth annual meeting' should have been 'thirtieth annual meeting'.

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. 158.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Packing Fractions of Krypton and Xenon

THE lines produced in mass spectra by hydrocarbon molecules have always played a predominant part in the accurate measurements of mass. This is particularly so in the use of the doublet method, since their high masses, due to the hydrogen, tend to provide easily resolvable doublets with ordinary atomic lines. With methane and ethane there is no difficulty in producing all the lines of the C_1 and C_2 groups, but when propane is used in a cylindrical discharge tube, only the first four lines of the C_3 group, 36, 37, 38 and 39, have a workable intensity. These were used in the measurements of the isotopes of chlorine[1]. Fortunately, the lower pressure discharge in an eight-inch bulb gives all the lines up to C_3H_8, though the even ones, 40, 42, 44, are weaker than the others. This has enabled comparisons to be made with the multiply charged lines of krypton and xenon, giving direct measurements of their packing fractions much more accurate than the indirect ones made ten years ago[2]. The following are the results :

Doublet		Number of doublets measured	Difference in packing fraction	Difference of mass
$^{78}Kr^{++}$	$- C_3H_3$	4	$16{\cdot}28 \pm 0{\cdot}2$	0·0635
$^{82}Kr^{++}$	$- C_3H_5$	19	$20{\cdot}20 \pm 0{\cdot}15$	0·0828
$^{84}Kr^{++}$	$- C_3H_6$	20	$21{\cdot}73 \pm 0{\cdot}15$	0·0913
$^{86}Kr^{++}$	$- C_3H_7$	18	$23{\cdot}10 \pm 0{\cdot}15$	0·0993
$^{129}Xe^{+++}$	$- C_3H_7$	14	$20{\cdot}16 \pm 0{\cdot}1$	0·0867

Presence of traces of argon in the tube prevented any accurate determination of ^{80}Kr. Measurements of $^{132}Xe^{+++}$ by the doublet at 44 were unsatisfactory owing to the presence of CO_2, but its packing fraction appears to be nearly the same as that of ^{129}Xe, and is given provisionally.

The following are the packing fractions and isotopic weights deduced from values of hydrogen and carbon of 1·00812 and 12·00355 respectively :

Symbol	Packing fraction	Isotopic weight
^{78}Kr	− 7·30	$77{\cdot}9430 \pm 0{\cdot}0020$
^{82}Kr	− 7·70	$81{\cdot}9369 \pm 0{\cdot}0015$
^{84}Kr	− 7·60	$83{\cdot}9362 \pm 0{\cdot}0015$
^{86}Kr	− 7·40	$85{\cdot}9363 \pm 0{\cdot}0015$
^{129}Xe	− 4·46	$128{\cdot}9424 \pm 0{\cdot}0020$
^{132}Xe	(− 4·4)	(131·942)

F. W. ASTON.

Cavendish Laboratory,
Cambridge.
July 9.

[1] NATURE, 138, 1094 (December 26, 1936).
[2] *Proc. Roy. Soc.*, A, 115, 506 (1927).

The Two Crystalline Modifications of Insulin

PROF. E. B. MATHEWS' first examination of Abel's crystalline insulin showed the presence of two types of insulin crystals[1]. One of these, the so-called prismatic or needle variety, had marked birefringence and a development of faces strongly suggestive of rhombohedral symmetry, the crystals being elongated along the trigonal axis. Crystals of this type are commonly wedge-shaped, and very small wedge-shaped crystals have also been obtained by Scott[2] by crystallization of insulin from acetate buffers at *p*H 5·2. The more common variety of insulin crystals are those obtained first by Abel[3] from phosphate buffers at *p*H 6·2. These are very small flat rhombohedra appearing isotropic as usually viewed along the trigonal axis, but having actually positive birefringence. X-ray examination has here shown the presence of a simple rhombohedral unit cell[4]. It has been usual in the literature to describe these two forms—prismatic and rhombohedral—as polymorphic modifications[5].

Through the kindness of Prof. F. L. Pyman, I have now had the opportunity of examining also insulin crystals of the prismatic type by the X-ray method. Two preparations were available. One of these consisted of very small crystals roughly wedge-shaped in outline and frequently twinned in cross forms as described by Mathews. As these crystals were only 0·05 mm. long and less than 0·01 mm. across, they could not be used for X-ray measurements. But there seems no doubt that the second preparation is identical with this, though here the crystals showed no identifiable faces. They were roughly needle-shaped masses up to 0·3 mm. long and rather less than 0·1 mm. in cross-section, extinguishing uniformly between crossed nicols and showing, as do the small wedge-shaped crystals, positive birefringence.

These needle-shaped crystals gave on X-ray examination photographs identical in the spacings and intensities of the X-ray reflections with those obtained from the original 'rhombohedral' crystals. The crystal structure is therefore the same in the two forms, and these are not polymorphic modifications though the change in habit is certainly very striking. Even here there is evidence that forms intermediate between the two varieties may occur. One sample of insulin, recrystallized from sodium dihydrogen phosphate and acetic acid, consisted very largely of small crystals showing nearly equal development of rhombohedral and prismatic (or more probably steep trapezohedral) faces, which gave them at first sight the appearance of rhombic dodecahedra. These crystals were much too small for X-ray examination, but the possession of positive birefringence combined with the symmetry leaves little doubt of their identity with the other two varieties.

In one respect only do the X-ray photographs of the needle crystals appreciably differ from those of the original rhombohedra. They all show a much more marked diffuse ring with a spacing of about 4·5 A., a value we have come to consider characteristic of the presence of 'amorphous' proteins[6]. Here it may be due to imperfections of the crystal following perhaps partial breakdown. But amorphous proteins such as gelatin are known to have a marked effect on the habit of both organic and inorganic crystals; and it seems possible that a similar influence appears here, amorphous insulin or a breakdown product being included in the crystals and being itself responsible for the adoption of the prismatic form.

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June 29.

[1] Abel, J. J., Geiling, E. M. K., Rouiller, C. A., Bell, F. K., and Wintersteiner, O., *J. Pharm. Exp. Ther.*, **31**, 84 (1927).
[2] Scott, D. A., *Trans. Roy. Soc. Canada*, (iii), **26**, 275 (1932).
[3] Abel, J. J., *Proc. Nat. Acad. Sci.*, **12**, 132 (1926).
[4] Crowfoot, D., NATURE, **135**, 591 (1935).
[5] cf. "Insulin" by D. W. Hill and F. O. Howitt (p. 51).
[6] cf. Astbury, W. T., Dickinson, S., and Bailey, K., *Biochem. J.*, **29**, 235 (1935).

Absolute Configuration of the Naturally Occurring α Amino-Acids

THANKS largely to the extensive researches of Levene and his collaborators, it now appears to be well established that, as suggested by Clough in 1918[1], the naturally occurring α amino-acids all possess the same configuration. Until recently, the absolute configuration was not known for any optically active compound, but in the course of a theoretical calculation of rotatory power, Boys[2] deduced a rule giving the absolute configuration of any enantiomorph from the sense of its rotation—namely, "that a dextro compound has the configuration such that, when the largest group is nearest to the hypothetical observer the other groups in order of diminishing size appear in a clockwise rotation".

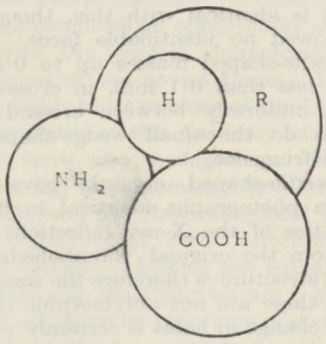

Fig. 1.

Boys's rule, which appears to have been accepted by Levene and Lowry, can only be applied with certainty in the absence of interactions of the solvent with the solute molecule, a condition which is far from being fulfilled by the amino-acids; marked solvent action is indicated in several cases by a complete change of sign of the rotation with temperature or with *p*H. The configurations of the amino-acids have, however, been correlated with those of other compounds in which solvent action is less; from the recent paper of Levene and Mardashew[3], the naturally occurring amino-acids have the configuration of lævo-rotatory 2-amino-hexane, a compound to which Boys's rule may be applied with more confidence.

If the validity of the rule and its applicability to this amine be accepted, then the naturally occurring α amino-acids, which amount to more than 95 per cent of most proteins, can be assigned the absolute configuration given in Fig. 1.

R. C. RAINEY.

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June 22.

[1] Clough, G. W., *J. Chem. Soc.*, **113**, 526 (1918).
[2] Boys, S. F., *Proc. Roy. Soc.*, A, **144**, 655 (1934).
[3] Levene, P. A., and Mardashew, S., *J. Biol. Chem.*, **117**, 707 (1937).

Use of Krypton-filled Ionization Chambers for Cosmic Ray Measurements

SOME years ago, compressed air and nitrogen were replaced by argon in cosmic ray ionization apparatus[1], argon being approximately twice as effective as nitrogen, which in turn is more effective than air.

Krypton is now used for filling special incandescent electric lamps, and is thus more easily available than hitherto. It was *a priori* probable that this gas of high atomic number would give much more favourable results than argon. The Gesellschaft für Lindes Eismaschinen, Germany, has kindly supplied me with compressed gas containing 94·5 per cent krypton and 5·5 per cent xenon. An ionization chamber was filled with the gas under a pressure of 12 atm. Only a few measurements could be carried out with the apparatus, as in consequence of an accident the greater part of the gas was lost. Nevertheless, the results obtained seem to be of interest to workers in that domain of science.

I had at my disposal two almost identical ionization chambers which were alternately filled with dry air under atmospheric pressure and with compressed krypton, argon or nitrogen. The chambers were of steel 5 mm. thick, had a volume of about 900 cm.^{3} each and their central electrodes were connected with Lindemann electrometers; they were exposed to the γ-rays from 0·4 mgm. radium at a distance of 120 cm.

Denoting by I_{air} the ionization in air of normal pressure and temperature, it was found:

$$I_{N_2}^{15\cdot5\ \text{atm.}}/I_{air} = 9\cdot5;\quad I_{Ar}^{15\ \text{atm.}}/I_{air} = 18\cdot9;$$
$$I_{Kr}^{12\ \text{atm.}}/I_{air} = 40\cdot2.$$

The ionization at these relatively low pressures is roughly proportional to pressure[2]. Reducing all measurements to the same pressure of 12 atm., we obtain the following relative ionization values for nitrogen, argon and krypton: 7·4; 15·1; 40·2. The nitrogen and argon used were of high purity; with commercial products, the superiority of krypton would be still more marked.

The γ-ray and cosmic ray ionization are generally proportional to each other. I undertook some experiments to test it in the case here concerned. My results are too incomplete to be quoted. It has been found, however, that the ionization due to cosmic rays is more than twice as great in krypton as in argon. It is thus obvious that the substitution of argon by krypton in ionization chambers will give a gain even more considerable than that which was

formerly obtained by substitution of air by argon. The usefulness of krypton for Geiger-Müller counters in cosmic ray research is also obvious.

Part of the expense for this investigation was covered by a grant from the Ministry of Education.

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Warsaw.
June 10.

[1] Compton, A. H., and Hopfield, J. J., *Phys. Rev.*, **41**, 539 (1932).
[2] Hopfield, J. J., *Phys. Rev.*, **43**, 675 (1933).

Ionization Energy of Li^+ and He

As a disagreement was found by Robinson[1] between measured and calculated values for the ionization potential of Li^+, I have made a direct calculation by the method described by Hylleraas[2]. The ionization potential in the 13th approximation is found to be 610,058 cm.$^{-1}$. This result is in good agreement with the value 610,054 cm.$^{-1}$ obtained from the Hylleraas' extrapolation formula for $Z = 3$.

To this value the following corrections are to be applied[3]: ε_3 (mass polarization correction—the elementary mass correction is contained in R_Z and therefore already taken into account), H_1 (relativistic change of mass with velocity), H_2 (magnetic interaction between the orbits), H_4 (spin correction, arising from a characteristic term in the Dirac theory), H_5 (relativistic correction for the remaining ion with one electron).

I have calculated the most important of these corrections, H_1 and H_4, using the best wave function with four terms. Bethe has made the same calculation using a less accurate wave function.

TABLE 1. RELATIVITY CORRECTIONS.

Correction unit	H_1 a^2R	H_4 a^2R	H_5 a^2R	Total a^2R	Total (cm.$^{-1}$)
New value	153·8	− 125·1	− 20·3	+ 8·4	+ 49
Bethe's ,,	130·4	− 111·6	− 20·3	− 1·5	− 8

H_2 is found to be very little ($= -2$ cm.$^{-1}$). Other corrections seem to vanish in our approximation.

TABLE 2.

Unperturbed ioniz. pot. (cm.$^{-1}$)	Total corrections H (cm.$^{-1}$)	Mass pol. corr.[4] (cm.$^{-1}$)	Total calculated (cm.$^{-1}$)	Experimental value[5] (cm.$^{-1}$)
610,058	47	− 5	610,100	610,079 ± 25

For He the agreement is not so good: the calculated value is 198,325 cm.$^{-1}$ (the unperturbed value is calculated by Hylleraas) and the experimental result is 198,305 ± 15 cm.$^{-1}$ (measured by Paschen). It seems that the theoretical values (even for heavier elements) lie somewhat higher than the experimental values, so the disagreement cannot depend upon the use of the variational method.

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Institute of Mechanics and
Theoretical Physics,
Uppsala. June 7.

[1] Robinson, *Phys. Rev.*, **51**, 14 (1937).
[2] Hylleraas, *Z. Phys.*, **65**, 209 (1930).
[3] Bethe, "Handb. d. Physik", vol. 24/I, p. 324, *et seq.*
[4] Edlén, *Nova Acta Reg. Soc. Sci. Ups.*, (7) **9**, No. 6, and Robinson, *Phys. Rev.*, **51**, 14 (1937).

The O-H Raman Frequency in Inorganic Acids

THE band characteristic of the OH group has been recorded in the Raman spectra of many hydroxides and alcohols. It has not so far been observed, however, in the case of the stronger acids. Using the improved technique of complementary filters recently developed by Ananthakrishnan[1], and giving long exposures varying from six to twelve days, I have succeeded in obtaining spectra with sulphuric acid and crystals of iodic, selenious and telluric acids, in which the band is clearly seen in the 4046 A. excitation. Table 1 gives the frequency shifts. The value for boric acid is taken from Ananthakrishnan's paper[2].

TABLE 1.

Substance	Raman frequencies of the OH band (cm.$^{-1}$)		
	Beginning	Middle	End
H_2SO_4 (100%) liquid	2794	2985	3172
HIO_3 crystals	2834	2979	3125
H_2SeO_3 ,,	2973	3057	3141
H_6TeO_6 ,,	2985	3121	3257
H_3BO_3 ,,	—	3172, 3256	—

The following points may be noted: (1) The OH frequency in these acids is represented by a band which is weak, broad and diffuse as compared with the other vibration frequencies. (2) The OH group, which gives a sharp line at 3608 in potassium hydroxide and a broad band at about 3660 in ethyl and methyl alcohols, gives a much lower frequency in the inorganic acids. (3) There is a progressive fall in the characteristic frequency shift and a diminished intensity of the band with increasing strength of the acid. (4) In the case of sulphuric acid, the band appears to be resolved into two components.

The fact that the OH band has not hitherto been recorded in the Raman spectra of acids has been regarded by some investigators[3] as supporting the hypothesis of the existence of the so-called hydrogen bond[4] in oxy-acids and their salts. Now that the OH band has actually been recorded, this view evidently requires some modification. We have in fact to postulate the existence of the OH bond in acids as well, but considerably weakened as compared with the strength of the bond in alkalis and in weak acids. It may be mentioned in this connexion that Badger and Bauer[5] have recently observed an infrared absorption band in the region of 3μ in sulphuric acid, and they ascribe it to the presence of the OH group. These authors have drawn the inference that the so-called hydrogen bond and the hydroxyl bond postulated by Bernal and Megaw[6] are only extreme cases of one and the same phenomenon. This view appears to be supported by the investigation reported above.

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June 13.

[1] Ananthakrishnan, R., *Proc. Ind. Acad. Sci.*, A, **5**, 76 (1937).
[2] Ananthakrishnan, R., *Proc. Ind. Acad. Sci.*, A, **5**, 200 (1937).
[3] Hilbert, G. E., Wulf, O. R., Hendricks, S. B., and Liddell, U., NATURE, **135**, 147 (1935).
[4] Latimer, W. M., and Rodebush, W. H., *J. Amer. Chem. Soc.*, **42**, 1419 (1920).
[5] Badger, R. M., and Bauer, S. H., *J. Chem. Phys.*, **5**, 369 (1937).
[6] Bernal, J. D., and Megaw, H. D., *Proc. Roy. Soc.*, A, **151**, 384 (1935).

Surface Migration of Barium

J. A. BECKER[1,2] has described experiments from which he concluded that barium, deposited on one side of a flat tungsten ribbon, could, under given conditions, move to the opposite side. The thermionic emission measurements from each side of the ribbon indicated that barium deposited on one side migrated until each side was covered with half the original amount.

We have been engaged in observing the behaviour of oxide-coated emitters on nickel and tungsten, for which purpose we have used an electron microscope. In the light of Becker's results, we were surprised to find that, although barium could spread across a nickel or tungsten surface on which it had deposited, it could do so only when evaporation was possible. Our results did not, therefore, provide any direct evidence of surface migration.

We have since repeated Becker's experiments with both nickel and tungsten. The apparatus used by Becker is only briefly described in the references[1,2] given, but in his paper[3] on the diffusion and migration of thorium on tungsten, he describes in detail the apparatus employed. In our experiments, we used an apparatus similar to that described there. In this apparatus, precautions are taken to separate the thermionic emission from each side of the ribbon.

Our results have failed to reveal any evidence of surface migration of barium either on nickel or tungsten. In each case, the thermionic current measured at any time from the clean side was considerably less than one per cent of that obtained from the contaminated side, even after 16 hours' running at 1,100° K., the temperature at which Becker concludes migration rapidly takes place.

We hope to publish full details of both our electron microscopic and thermionic investigations in the near future.

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G.E.C. Research Laboratories,
Wembley.
June 17.

[1] *Trans. Amer. Electrochem. Soc.*, **55**, 160 (1929).
[2] *Trans. Faraday Soc.*, **28**, 155 (1932).
[3] *Phys. Rev.*, **43**, 428 (1933).

The Ground State of the Se_2 Molecule

THE diatomic molecules of the lighter elements of the sixth family of the Periodic Table, like O_2, S_2, SO, have $^3\Sigma$ terms as their ground states. There is some doubt if this still prevails with the heavier elements of that group. Spectroscopic investigations have so far not been able to show whether the ground states of Se_2, Te_2, SeO, etc., are $^3\Sigma$ or $^1\Sigma$ states.

So it appeared worth while to ascertain the magnetic properties of Se_2 vapour. With all precautions necessary to avoid contamination by oxygen, selenium was sealed in a silica tube under vacuum, and the influence of a magnetic field on it was determined at different temperatures between 20° C. and 1,100° C. The vapour in the tube consists of Se_6 and Se_2, being practically all Se_6 at low temperatures and changing more and more to Se_2 as the temperature rises. Along with the formation of diatomic molecules, a strong paramagnetic influence appeared, rapidly increasing as the quantity of diatomic vapour increased. This establishes the fact that the ground level of Se_2 is $^3\Sigma$.

A full account will be given in the *Proceedings of the Indian Academy of Sciences*, Bangalore.

Experiments on tellurium to the same effect are in progress.

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June 18.

A Psycho-geometrical Representation of Personnel Organization

LARGE industrial and other concerns represent their personnel organization diagrammatically by means of a chart having the form of a genealogical table. Properly constructed, this chart gives concise information as to individual rank and duties and relations, but no information regarding fundamental functions and mentality types at different levels. Moreover, the chart conveys the impression of descent instead of growth, differentiation and organic unity. It is therefore biologically unscientific and inadequate for administrative educational purposes.

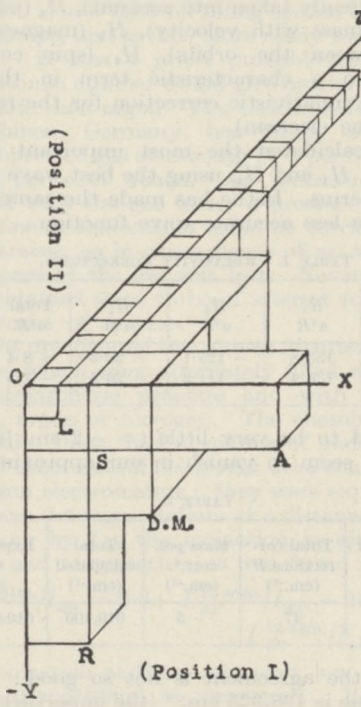

Fig. 1.

The above defects can be remedied by employing the co-ordinate system. In Fig. 1 (of which a solid model in colours has also been constructed), the *OX* axis represents breadth of knowledge or the administrative function, and *O–Y* depth of knowledge or the research function. It will be apparent that the administrative mind is represented by a horizontal rectangle (*A*), the research or advisory mind by a vertical rectangle (*R*), and departmental management, supervision and labour by squares of decreasing size (*D.M.*, *S* and *L*). *A*, *R* and *D.M.*, though always different in form and function, *may* be equal in area or total knowledge and ability. These conceptions

constitute a helpful guide in educational training, including the important matter of mental contact. The projection (*OZ* axis) represents numbers only. It enables diagrams to be constructed representing the functional organization, in terms of mental types, of different concerns. Tentative trials have yielded interesting results. This method of representation, therefore, in psychological hands, has a research value.

It may be noted that *OX* also measures responsibility and power in the administrative sense. Remuneration increases from *O* to *X* in rapid geometrical progression ($r=2$); from *O* to *-Y* it tends to increase only in slow arithmetical progression ($d=1$). This is due largely to demand and the factor of scarcity. It may be noted that knowledge and information characteristically pass along the path *-YOX* and decisions or orders along *XO-Y*.

In Position II, the appearance of a building is not altogether fortuitous, since there is a fixed and real relationship between numbers and space, even if that between rank and altitude is only analogical. It may be noted that the modern idea of 'functional control' (for example, a personnel department 'intruding' into all other departments in respect of its function) can be represented clearly by lines drawn obliquely in the *XOZ* plane.

In the next two positions the figure facilitates the explanation of other ideas of considerable importance, but with which it is unnecessary to deal in the present communication.

W. R. DUNLOP.

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June 5.

Phosphorus and Calcium Deficiency Diseases as Two Ætiologically Distinct Entities

Phosphorus Deficiency

VITAMIN D deficiency in most species of animals leads to the development of rickets, and Kay's suggestion that the real cause of experimental rickets produced under conditions of vitamin D deficiency is the assimilation of insufficient dietary phosphorus is interesting. Certainly this opinion is strengthened by the observation that low vitamin D rickets is indistinguishable from that produced by phosphorus-deficient diets in the presence of abundant vitamin D. The disease is referred to as rickets in the immature animal and as osteomalacia in the adult.

Theiler produced evidence in 1932 that rickets or osteomalacia in bovines kept under conditions of abundant vitamin D was invariably associated with insufficient dietary phosphorus. Subsequent work at this Institute has shown this to be true for other species of domestic animals in addition to the ox. Experimental rickets, due only to insufficient phosphorus in a diet adequate in all other respects, has been produced in cattle, goats, sheep, pigs, and, recently, indications of it have been observed in the horse. Details of these experiments are being published and leave no doubt that insufficient dietary phosphorus is the causal factor in the production of rickets under conditions of vitamin D sufficiency, while insufficient calcium in the diet does not produce rachitic lesions but an entirely different bone disease.

Calcium Deficiency

It is well known that low calcium in the rations of horses, especially if excess phosphorus be present, produces ostodystrophia fibrosa (Sturgess and Crawford, Kintner and Holt, Niimi, Theiler, etc.) but not rickets. Actually, true rickets in the horse has not yet been described in the literature. Furthermore, osteodystrophia fibrosa (osteofibrosis) is known to occur also in the goat, the dog and in some other animals, but so far its occurrence has not been associated with calcium-low diets.

At this Institute an 8-months old calf receiving daily in the diet 3 gm. calcium (CaO) and an excessive quantity of phosphorus (30 gm. P_2O_5), developed marked osteofibrosis and bone atrophy after 13 months. Abundant vitamin D was present. Two calves of the same age and receiving the same ration except that the phosphorus content was reduced to 15 gm. P_2O_5 developed osteoporosis and severe osteofibrosis during the same period. A fifteen months old steer receiving daily in his ration 4 gm. CaO and insufficient phosphorus (4 gm. P_2O_5) developed rickets as a result of the phosphorus deficiency shortly after the beginning of the experiment and osteofibrosis in virtue of the calcium deficiency after 31 months, severe rickets and bone atropy still being present. The same ration supplemented to contain abundant calcium (31 gm.) produced severe rickets and osteoporosis due to the phosphorus deficiency, but no osteofibrosis in a steer of the same age.

Moderate osteofibrosis was produced in a goat and in a pig receiving low calcium high phosphorus in their diets, but possibly the wide ratio of calcium to phosphorus was also responsible for the severity of the disease. Osteofibrosis has not yet been produced in sheep fed on a diet low in calcium.

Osteoporosis is merely the result of increased bone resorption; it is indicative of abnormal Ca : P metabolism, and is a transient stage in the evolution of some osteodystrophic diseases. It invariably accompanies the development of both rickets and osteofibrosis.

The most probable explanation for the relative rapidity with which rickets was produced by phosphorus-deficient diets compared with the appreciably longer time osteofibrosis took to develop when the rations were low in calcium, is that the functions of these two minerals in the animal body differ widely. Practically all the body calcium is required for bone formation and is present in the skeleton, whereas the demands for the much more widely functioning phosphorus are far more varied than for calcium. In other words, the need for metabolic phosphorus, other than that required for ossification, probably plays as important a part in the production of rickets as a deficiency of phosphorus for bone formation alone, and hence rickets due to phosphorus deficiency appears more rapidly than osteofibrosis due to a deficiency of dietary calcium.

It is interesting to note that, in all Marek's experiments with pigs, osteofibrosis was produced only when calcium was low or lower than phosphorus. No significance was attached by Marek to this apparent association of osteofibrosis with reduced calcium in the diet, probably because the work was done under conditions of vitamin D deficiency, and hence rickets developed in every case where osteofibrosis was produced, thus masking the association of osteofibrosis with abnormal calcium metabolism.

Our conclusion is that when enough vitamin D is present, a deficiency of phosphorus in the diet of cattle, sheep, goats and pigs produces rickets only, whereas a deficiency of dietary calcium produces

osteofibrosis uncomplicated by rickets—certainly in cattle and horses and probably also in pigs and goats. Osteoporosis in invariably associated with both diseases.

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A. I. MALAN.

Onderstepoort,
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May 18.

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Effects on Ovariectomized Rats of Progesterone Alone and in Combination with the other Sexual Hormones

AN experiment on ovariectomized rats in relation to this question has been performed by Selye, Browne and Collip (1936)[1]. They obtained progestational changes in the uterus and vagina of four out of six rats injected daily for 19 days with 30 γ of œstrone and 400 γ of progesterone.

We performed our experiments on 101 ovariectomized rats, which were injected with progesterone alone (up to 500 γ daily) or in various combinations with œstrone (the dose of œstrone varying from 1 γ three times a week to 30 γ daily) or œstradiol (30 γ daily or three times a week). The dose of progesterone used in these combinations varied from 500 γ to 3000 γ daily. Preliminary injections of 6 γ of œstrone were given four times a week for 10 days before the first progesterone injection was added. The period of injection was usually 20 days or, in a few experiments, 27 days.

The injection of progesterone alone (500 γ a day) brought about only a slight hypertrophy of the uterine epithelium and an occasional cystic mucification of some of the cells of the vaginal epithelium. The uterus and vagina remained atrophic, the average increase in weight being very small.

With the combined injections with œstrone or œstradiol, the nearest approach histologically to the picture of the normal pregnancy uterus and vagina was obtained by the use of 1 γ of œstrone three times a week with 1,500 γ of progesterone daily. Increasing the dose of œstrone, even to only 6 γ, or decreasing the dose of progesterone, resulted in a decrease or, with some doses, even in the disappearance of the progestational changes, especially those in the uterus. Even the combination of 30 γ of œstradiol three times a week with 3,000 γ of progesterone daily (that is, increasing both doses simultaneously) gave uterine progestational changes which were less than those obtained with the first combination 1 γ : 1,500 γ.

While, however, with some of the combinations mentioned above the histological structure of the uterus and vagina showed typical progestational changes, both the size and weight of these organs with all doses were considerably less than those during pregnancy (the sterile horn of a pregnant rat was used for the comparison of the uterine changes). In fact, the uterus was even much smaller than that of the normal rat in dioestrus.

We have shown previously[2] that the so-called 'male' hormones, especially testosterone and testosterone propionate, when combined with œstrone, produce progestation-like changes in the sexual organs of ovariectomized rats, while at the same time these organs hypertrophy considerably. It is also known that the male sexual hormones (not identified) are present in the female organism. Taking these facts into consideration, various doses and combinations of testosterone, testosterone propionate and Δ^4-androstenedione (150–500 γ daily) were added to the combination of progesterone and œstrone. A considerably improved general development was obtained in the uterus and vagina which, with some combinations of the hormones, approached that seen in pregnant animals. The myometrium considerably increased. The progestational changes in the mucosa, however, decreased somewhat after these additions.

The nearest approach to the 'pregnant' uterus and vagina was obtained in most of the rats injected with the following combinations and doses:

(1) test. prop. 300 γ + prog. 2,000 γ + œstrone 6 γ;
or (2) test. prop. 500 γ + prog. 500 γ + œstrone 6 γ;
or (3) testosterone 500 γ + prog. 1,500 γ + œstrone 1 γ;
or (4) testosterone 500 γ + prog. 500 γ + androstenedione 500 γ + œstrone 6 γ.

We wish to express our gratitude to Prof. W. Schoeller and Messrs. Schering, Ltd., for kindly supplying us with progesterone, to Messrs. Ciba, Ltd., in particular to Dr. K. Miescher, for the supply of testosterone, testosterone propionate and androstenedione, and to Prof. A. Girard for œstrone and œstradial.

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June 25.

[1] Selye, Browne and Collip, *Proc. Soc. Exp. Biol. and Med.*, **34**, 198 (1936).
[2] Korenchevsky and co-workers, NATURE, **135**, 434; **136**, 185 (1935); **137**, 494 (1936). *Biochem. J.*, **29**, 2534 (1935); **30**, 558 and 1514 (1936); **31**, 467, 475 and 780 (1937). *J. Path. and Bact.*, **42**, 91 and 345 (1936).

Excretion of Nitrogen by Leguminous Plants

SINCE 1927, Virtanen and co-workers[1] have published results of numerous experiments which confirm and greatly extend the observation of Lipman[2] that certain leguminous plants when fixing nitrogen excrete part of this into the quartz sand subtrate, and if a non-leguminous plant is present, it may utilize the excreted form. The extensive data compiled by Virtanen and collaborators prove definitely that true excretion occurs with several of the legumes, but there exists an equally impressive body of experimental data which demonstrates conclusively that excretion is not *universally* obtained.

The original experiments of Lipman included only twenty-six cultures free of combined nitrogen thus capable of supplying clear-cut evidence. With respect to excretion, six of these were positive and twenty were negative. Examination of Stalling's data[3] shows no evidence of benefit to wheat when grown with soy beans. Ludwig and Allison[4] report no excretion with cow-pea, lucerne, vetch and sweet pea, as does Bond[5] with soy bean.

Since 1933 we have studied this problem using in most of our experiments a pea-oat mixture, but in certain ones lucerne, soy beans and red clover were included. In fifteen experiments, more than two hundred plant cultures grown under a wide range of

experimental conditions have been examined, but in no case has excretion been detected either by benefit to non-legume in association or through analysis of the sand.

At the invitation of Prof. Virtanen and with the aid of Dr. S. v. Hausen, I conducted experiments at the Biochemical Institute in Helsingfors during the fall of 1936. In spite of unfavourable weather, which restricted nitrogen fixation, definite evidence of excretion was obtained with peas grown in sterile containers. The experiments were repeated this spring at Madison under identical conditions with the exception of the sand used—and of necessity with different environmental conditions, for example, type of greenhouse and weather conditions. In these experiments, excretion has been detected in *part*, but not *all*, the cultures independent of the quantity of nitrogen fixed. The cause of the discrepancies is not readily apparent, but the chief factor in associated cultures appears to be the manner of development of the plants. Our experiments indicate that excretion may be profoundly affected both qualitatively and quantitatively by the species of plant, nature of substrate and in associated cultures by the relative rate of growth of the different species. An environment that delays the reproductive stage appears to favour the excretion process.

Without minimizing the importance of Prof. Virtanen's studies, especially as they relate to the chemical nature of the excreted compounds, it is emphasized that excretion of nitrogen by leguminous plants is not universally obtained, even under experimental conditions which are apparently identical. For this reason the questions as to whether the phenomenon actually occurs in the field and to what extent it is responsible for the beneficial effects of associated culture of legumes and non-legumes remain unanswered. Until the factors which control the process are defined and the origin of the discrepancies known, it should be recognized that application to practical agriculture is only an attractive possibility and not an established fact.

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Virtanen, *J. Soc. Chem. Ind.*, **54**, 1015 (1935).
[2] Lipman, *N.J. Agric. Expt. Sta. Bull.*, **253** (1912).
[3] Stallings, *Soil Sci.*, **21**, 253 (1926).
[4] Ludwig and Allison, *J. Bact.*, **31**, 93 (1936).
[5] Bond, NATURE, **139**, 675 (1937).

Succession of Broods of *Lebistes*

THERE seems to be a point in the natural history of *Lebistes* which is not generally known among those using this fish as a 'laboratory animal' in Great Britain. As it affects certain types of research very markedly, the following information will be of interest to those using this fish.

As a result of one mating, a female *Lebistes* may produce a succession of broods over a period of from six to eight months. From personal experience, I cannot vouch for the length of time mentioned (my authorities are Mellen and Lanier) as I am only now in the process of testing it, but that spermatozoa do remain alive within the body of the female and fertilize one brood after another is definitely established. The exact details of my data may be of interest. Mr. Gillespie sent me up some specimens from the Zoological Society of Scotland's Aquarium on February 3 last. As a result of the rigours of the journey, all were dead by the morning of February 5 except two females. Hoping for the best, I got no more, and one of the two, which has had no other companion except the other original one since, has produced the following broods: February 22, 3; March 28, 29; April 25, 58; May 27, 28. Judging from her present appearance, she is again an expectant mother!

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June 22.

Method for Fixing Neutral-red in Supra-vital Stained Blood Smears

IN blood smears from horses stained according to the ordinary methods Giemsa and May-Grünewald Giemsa, we encounter serious difficulties in the examination: first, to differentiate between large lymphocytes and small monocytes, secondly, to determine *qualitative* changes in the white blood corpuscles. In order to remedy this, we have employed as a supplementary method, in an extensive investigation into the white blood picture in the case of infectious anæmia in horses, supra-vital staining with neutral-red.

We mix in a test-tube neutral-red with citrate blood at body temperature in the ratio of 1 : 15,000. The test-tube is placed in a thermostat at 37° for 40 minutes. In the meantime, it is shaken up a couple of times. After that we make an ordinary cover-glass smear, allow it to dry in the air for 24 hours, *fix it with a saturated picric acid solution*, and then stain it with Mayer's hæmalin (that is, Mayer's original recipe without citric acid), and embed in cedar oil.

In this slide thus prepared from *normal* horses, there is a large granulated deposit of neutral-red in monocytes, eosinophiles and basophiles, while no neutral-red grains are discovered in neutrophiles and lymphocytes. The difference between the neutral-red in lymphocytes and monocytes makes differentiation easy. In slides from horses *suffering from infectious anœmia*, there occurs during an attack of fever a more or less large deposit of neutral-red also in the neutrophiles. It is often connected with degenerative changes. The degeneration is demonstrated by vacuoles in the protoplasm and karyopyknosis with strong lobation of the nucleus. We have been unable to discover in the sick horses any changes in the amount of neutral-red deposit in the other white corpuscles.

This method does not, of course, present any opportunity for the study of the live white corpuscles as does the method described by Simpson[1] and by Sabin[2], but in contradistinction to the latter it makes it possible to study the cells at leisure when fixation of neutral-red has been reached. The nuclear staining also largely facilitates the investigation. A great advantage is also the possibilities it presents in the study of qualitative changes in the neutrophile leucocytes.

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[1] Simpson, Univ. of California Pub. in Anat., **1**, No. 1.
[2] Sabin, *Bull. Johns Hopkins Hosp.*, **34**, 277, (1923).

Heterogeneous Equilibria with Deuterium

THE heterogeneous equilibria between hydrogen and the metallic chlorides have been extensively studied, notably by Berger and Crut[1] using a static method, and by Jellinek and his collaborators[2] using a dynamic method. More recently, Kapustinsky[3] has studied the reduction of cuprous chloride with both hydrogen and deuterium, using a static method. The agreement among the results of different authors is not very satisfactory and we are engaged in further investigations of heterogeneous equilibria involving hydrogen and deuterium.

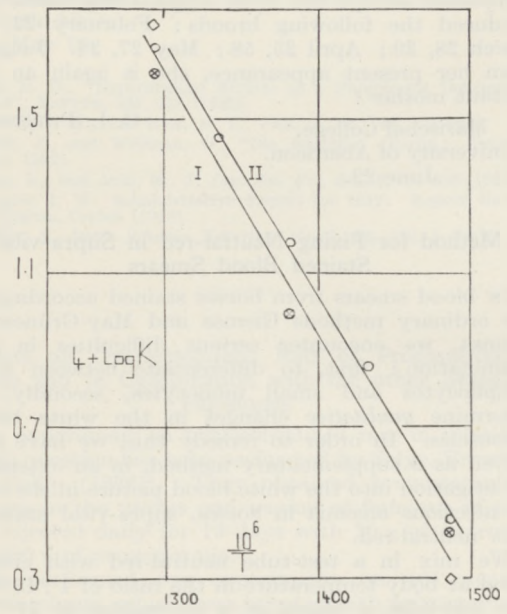

Fig. 1.

GRAPH I FOR HYDROGEN; GRAPH II FOR DEUTERIUM.

⊗, PARTINGTON AND TOWNDROW. (H_2)
○, „ „ „ (D_2)
◇, JELLINEK AND ULOTH. (H_2)

A static method has been used to study the reduction of cobalt chloride by hydrogen and deuterium. The cobalt chloride is heated with the gas at constant volume, the temperature being measured by a thermocouple, and pressure by a mercury manometer. The extent of the reaction is deduced from the increase of pressure due to the reactions:

$$CoCl_2 + H_2(D_2) = Co + 2HCl\ (2DCl)$$

The values of the equilibrium constant

$$K = C^2_{HCl}/C_{H_2}$$

obtained for hydrogen are in good agreement with those found by Jellinek and Uloth by a different method.

TABLE I.

	$H_2 + CoCl_2$			$D_2 + CoCl_2$				
T°	673	723	773	673	698	723	748	773
$10^6/T$	1486	1383	1294	1486	1433	1383	1337	1294
$4+\log K$	0·413 P. & T. 0·295 J. & U.	0·990 P. & T.	1·621 P. & T. 1·749 J. & U.	0·447	0·854	1·179	1·456	1·685

Table I shows the values of the equilibrium constant for hydrogen and deuterium at various temperatures. In Fig. 1 the logarithm of K is plotted against $1/T$, where T is the absolute temperature at which K is measured.

If K_1, K_2 are the equilibrium constants for the reactions:

$$CoCl_2 + H_2 = 2HCl + Co \quad . \quad . \quad . \quad (1)$$
$$CoCl_2 + D_2 = 2DCl + Co, \quad . \quad . \quad . \quad (2)$$

respectively, then $K^* = K_1/K_2$ is the equilibrium constant for the homogeneous reaction:

$$2DCl + H_2 = 2HCl + D_2, \quad . \quad . \quad (3)$$

namely, $K^* = C_{D_2} \cdot C^2_{HCl}/C_{H_2} \cdot C^2_{DCl}$

Urey and Rittenberg[4] have calculated values of K^* at different temperatures on theoretical grounds. These are compared in Table II with values obtained experimentally by Kapustinsky and ourselves.

TABLE II.

	$1 + \log K^*$				
T°	769	700	690	658	575
Urey and Rittenberg	0·96	0·94	—	—	0·91
Kapustinsky	—	—	0·78	0·70	—
Partington and Towndrow	0·92	0·89	—	—	—

The heats of reaction ($Q_v = \Delta U$) of reactions (1) and (2) above are deduced from graphs I and II to be −31,850 gm. cal./mol and −30,790 gm. cal./mol respectively, at a mean temperature of 450° C. The value given in the International Critical Tables for reaction (1) is −32,360 gm. cal./mol at 18° C. (determined thermochemically).

On plotting $\log K^*$ against $1/T$ a straight line is obtained from which the heat of reaction (3) is deduced to be −1,100 gm. cal./mol.

As would be expected from theoretical considerations, the value of K^* tends towards unity with increasing temperature, and the difference from unity may be shown to be negligibly small at 800° C.

The investigation is being extended to other types of reaction.

J. R. PARTINGTON.
R. P. TOWNDROW.

Queen Mary College,
London. June 14.

[1] Berger and Crut, *C. R.*, **173**, 977 (1921).
[2] Jellinek and Uloth, *Z. phys. Chem.*, **119**, 161 (1926); Jellinek and Rudat, *Z. phys. Chem.*, **143**, 244 (1929).
[3] Kapustinsky, *J. Amer. Chem. Soc.*, **58**, 460 (1936).
[4] Urey and Rittenberg, *J. Chem. Phys.*, **1**, 142 (1933).

The Corona by Reflection from the Moon

THE light from the photosphere of the sun will illuminate not only the hemisphere of the moon facing the sun but also a zone five miles wide beyond the great circle bounding the hemisphere. A further zone five miles in width will be illuminated by those radiations emanating from the corona, if the height of the corona be regarded as equal to one radius of

the sun. The intenser light of the relatively low inner corona will fall on a narrow strip of this lunar zone, bordering upon the edge of the surface upon which the photospheric light is falling.

Let the slit of a spectrograph be placed across the illuminated portion of the moon's surface so that half the slit is projecting over the apparently unilluminated lunar surface. It will thus cross this five mile zone, which will be reflecting corona light. The spectrogram should reveal first a strip of the usual reflected sunlight; then, theoretically, the emission lines of the high chromosphere; and then the typical corona spectrum.

The practical difficulties involved are the very long exposure times which would be required to gather sufficient reflected corona light to give the image, and the very exacting requirements of guiding.

If one of the powerful long-focus telescopes were used for this investigation, and a 15-inch image of the moon were formed at the plane of the slit, then a five-mile strip of the moon's surface would be 0·95 mm. at the slit. Hence the need for very accurate guiding is obvious, so that the edge of photospheric illumination will not encroach upon this critical millimetre of the slit.

Since earthshine is strongest upon the moon during its early phase, this would not be a good time, but at and near half moon would seem to be the most favourable period.

In Fig. 1, *AM* is the radius of the sun; *MN* indicates the region of the corona; *B* is the moon; *PEM* is tangent to both moon and sun, and *QFN* is tangent to moon and corona. Thus *EG* bounds the photospherically illuminated portion of the moon, while *EG* and *HF* define the zone illuminated only by coronal light. Obviously this narrow strip of the moon's surface presents the largest target as viewed from the earth at first and third quarter.

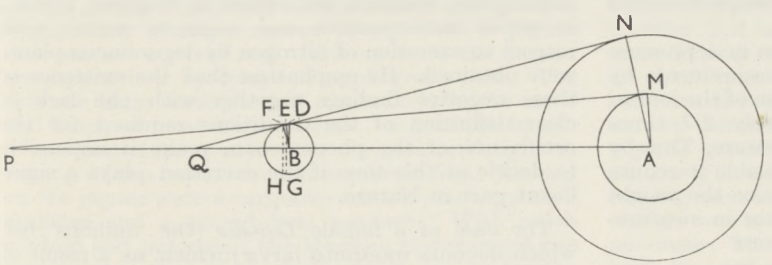

Fig. 1.

The director of Mount Wilson Observatory has expressed his interest in this proposed method of investigating the corona, and suggests the desirability of having the method tried out at more than one observatory.

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May 11.

Viscosity of Binary Mixtures

THE equation[1]

$$\log \eta = N_1 \log \eta_1 + N_2 \log \eta_2 \qquad (1)$$

which is advanced by Dr. Lederer to give η, the viscosity of an ideal binary mixture, assumes that N_1 and N_2 are the physical molecular weights of the liquids 1 and 2 the viscosities of which are respectively η_1 and η_2.

Now, if S_1 and S_2 are the association factors for the respective liquids, then the relation between m_1 and m_2, the chemical molecular fractions of the liquids, and N_1 and N_2 is:

$$N_1 = \frac{m_1/S_1}{m_1/S_1 + m_2/S_2} = \frac{m_1 S_2}{m_1 S_2 + m_2 S_1} \qquad (2)$$

$$= \frac{m_1}{m_1 + m_2 S_1/S_2}$$

If $S = S_1/S_2$,
then

$$N_1 = \frac{m_1}{m_1 + m_2 S} \text{ and } N_2 = \frac{m_2 S}{m_1 + m_2 S} \qquad (3)$$

S in equation (3) is, therefore, the ratio of the association factors of the liquids 1 and 2, respectively.

In Dr. Lederer's communication[1] the factor S is defined as the degree of association of component 2, but it would appear more correct to define S as the ratio of the association factors as derived in (3) above.

A further matter of interest is that the value of S varies (for the system benzyl benzoate in toluol at 25° C.—Kendall and Munroe's data) by 4 per cent about the mean value, as shown in the accompanying table.

m_1	$S = S_1/S_2$	
0·2367	0·805	
0·4261	0·818	
0·6502	0·840	Mean value 0·836
0·7890	0·862	
0·9002	0·860	

m_1 is the chemical molecular fraction of benzyl benzoate in toluol taken from Kendall and Munroe's data. Kendall and Munroe, however, showed that the freezing point data of solutions of benzyl benzoate in toluol were normal, whence S_1 = unity; hence the *average* value of S_2 = 1·197, that is, the average degree of association of *toluol* is 1·197 in this solution. Dr. Lederer referred the value 1·197 to benzyl benzoate as an association factor, and in so doing appears to be in error.

It may be observed that an excellent test for the veracity of equation (1) above would be provided by an ideal binary mixture of components of approximately equal viscosity characteristic, because it is clear from relation (1) that if $\eta_1 = \eta_2$, then $\eta = \eta_1 = \eta_2$. Such a mixture should, of course, show no heat effects on mixing and have the general characteristics which guided Kendall and Munroe in accepting benzyl benzoate in toluol as an ideal mixture. An approximate test obtains with the system propyl acetate + benzol—a system showing but a small heat effect on mixing—and, in this case, the value η is less than η_1 or η_2, whence equation (1) cannot apply. Dr. Lederer's fundamental equation

$$\log \eta = m_1 \log \eta_1 + m_2 \log \eta_2 - \int \frac{qm}{4{\cdot}57T^2}, \qquad (4)$$

however, provides for such cases where the integral involving the molecular heat of solution qm must be evaluated.

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[1] NATURE, 139, 27 (1937).

Use of the Word Substrate

IN recent years, the practice has grown up among workers in surface chemistry of using the word 'substrate' to denote the bulk phase underlying a surface film, regardless of the fact that this word has been in general use for a much longer time to denote the substance upon which an enzyme acts. The name as applied to a bulk phase on which a surface film rests would seem harmless enough in most cases, but since it is almost certain that, in enzyme action, the substance acted on is adsorbed, probably locally and one molecule thick, on the surface of the enzyme, the same word 'substrate' will have to do duty *both* for the underlying, and more bulky, enzyme, *and* for the small molecules upon which the enzyme acts!

If the words 'subtratum', or 'underlying liquid' (or solid, as the case may be) were used instead of substrate for the denser phase adjoining a surface film, I think this inconsistency, and possible source of confusion, in nomenclature, would be simply avoided.

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London, W.C.1.
July 1.

Points from Foregoing Letters

THE isotopic and packing fraction of krypton atoms of mass 78, 82, 84, 86, and of xenon atoms of mass 129, have been determined by Dr. F. W. Aston, by comparison with hydrocarbon 'doublets', by means of the mass spectrograph.

Dr. D. Crowfoot reports that the birefringent insulin crystals of prismatic type obtained by crystallization from acetate buffers at *p*H 5·2 gives similar X-ray patterns to those shown by the usual rhombohedral form, except for a more marked diffuse ring which may be due to the prevalence of amorphous matter, probably responsible for the prismatic form.

The probable absolute configuration of the naturally occurring α amino-acids has been demonstrated by R. C. Rainey by the application of Boys's rule to 2-amino-hexane, the configuration of which has recently been correlated with that of the amino-acids by Levene and Mardashew; solvent action prevents the direct application of the rule to the amino-acids themselves.

Dr. St. Ziemecki, by replacing argon in a pressure ionization chamber for cosmic ray measurements by krypton, finds the effect was an increase of the ionization current, which was approximately 2·7 times greater than with argon at the same pressure. Thus by using krypton-filled chambers, it is possible to reduce greatly the pressure employed and hence the weight of the apparatus, which is of importance in measurements in high regions of the atmosphere.

By applying a number of corrections (due to mass-polarization, relativistic change of mass with velocity, magnetic interaction between the orbits, etc.) to the calculated value of the ionization potential of lithium atoms, H. A. S. Eriksson finds a value of 610,100 cm.$^{-1}$ in fair agreement with the experimental value. For helium, the agreement is not so good. Theoretical values are somewhat higher than experimental ones.

A band in the region of 3000 A. of the Raman spectra of several inorganic acids observed by Dr. C. S. Venkateswaran is attributed by him to the presence of the OH group. The author gives a table showing the frequency limits of the bands in the cases of sulphuric, iodic, selenious, telluric and boric acids and, from their broad and diffuse nature, deduces that the OH group, though present in these acids, is much weaker in strength than the OH group present in the alkalis.

The surface migration of barium on to the opposite side of nickel and tungsten ribbon used in thermionic emission valves, as reported by J. A. Becker, is not confirmed by Dr. M. Benjamin and R. O. Jenkins, even after sixteen hours running at 1,100° K.

Prof. S. S. Bhatnagar, Dr. H. Lessheim, and Mohan Lal Khanna find that the diatomic vapour of selenium is paramagnetic, which fact agrees with the view that the ground[1] level of Se_2 is $^3\Sigma$.

Experiments on animals are described by Dr. P. J. Du Toit and A. I. Malan to show that rickets result from a deficiency of phosphorus, even in the presence of vitamin D. Lack of calcium, on the other hand, leads to osteofibrosis.

Dr. V. Korenchevsky and K. Hall find that suitable combination of female and male sex hormones (progesterone, œstrone, testosterone and androstenedione) bring about normal pregnancy changes in the uterus and vagina of ovariectomized rats.

Prof. P. W. Wilson describes experiments made at Helsingfors, Finland, and others at Madison, U.S.A., in which both positive and negative results with respect to excretion of nitrogen by leguminous plants were obtained. He emphasizes that the existence of these negative findings together with the lack of clear definition of the conditions required for the occurrence of the phenomenon, make it impossible to decide at this time if the excretion plays a significant part in Nature.

The case of a female *Lebistes* (the 'millions' fish which devours mosquito larvæ) which, as a result of a single mating has produced a succession of broods over a period of several months, is reported by G. L. Purser.

A method of staining smears with neutral-red, enabling one to differentiate between lymph-cells and small monocytes and to indicate qualitative changes in the white blood corpuscles (in infectious anæmia in horses) is described by A. Hjärre and H. Berthelsen.

The equilibria between cobalt chloride, and hydrogen and deuterium have been studied by Prof. J. R. Partington and R. P. Towndrow. Values of the equilibrium constant have been obtained at different temperatures, and from these the heats of reaction have been calculated.

ERRATUM.—Referring to his letter entitled "Collision of Two Oil Drops and the Stability of a Non-spherical Oil Drop", which appeared in NATURE of July 10, p. 70, Mr. Yoshio Ishida writes that owing to an error in the manuscript, 'oblate' should read 'prolate', and vice versa.

Research Items

Votive Offerings from Chichen Itza, Yucatan

ACCORDING to a recent announcement of the Carnegie Institution of Washington, D.C., some remarkable votive or possibly foundation offerings were found in the course of recent excavations at Chichen Itza, the famous city of the New Empire of the Maya of Yucatan, which flourished from the middle of the eleventh century of our era almost down to the coming of Columbus and the time of the Spanish conquest. The Carnegie Institution, which is working in co-operation with the Bureau of Pre-Hispanic Monuments of the Mexican Government, has been engaged in the exploration of El Castillo, the pyramid temple of the Maya god Kukulcan. This temple, built on top of a pyramidal structure, encloses completely, it has been found, an earlier temple and pyramid—a method of construction followed elsewhere in Yucatan. Excavation for the purpose of exploring the inner temple has led to some remarkable discoveries. In 1935, for example, a rectangular treasure box of limestone was found at the foot of a stairway. Its lid was a single stone, two and a half feet long by two feet wide. Among its contents were two turquoise mosaic plaques of great beauty, necklaces of coral, turquoise and jade, carved jade beads and pendants, and about 2,000 loose button-shaped beads of turquoise. The later find, made last season, was even more remarkable. In the inner chamber of the buried temple, of which the back wall was studded with the heads of human femora, presumably from sacrificial victims, there was found another box of squared limestone blocks, inside which was a throne fashioned from a single block of stone carved to represent a jaguar and painted a vivid red. The spots of the jaguar are represented by inlays of apple-green jade. The eyes are large hemispherical pieces of jade, the teeth and fangs of hard white stone. Its greatest length is two and three quarter feet, its greatest height to the top of the head, two and a quarter feet. Resting on the jaguar were a turquoise mosaic plaque, a shell necklace and a carved jade pendant. With much wisdom and judgment, the Mexican Government has decided that these finds shall remain *in situ* for the inspection of students and visitors.

Population Study of the Song Sparrow

MARGARET M. NICE has published a study, which extended over eight years, of a song sparrow population ("Studies in the Life History of the Song Sparrow 1. A Population Study of the Song Sparrow", *Trans. Linn. Soc. New York*, **4**, April 1937. 1 dollar 50 cents). Each adult bird was marked individually with coloured bands. The various aspects of the life-history are clearly set out, from which a selection follows. The bird is a partial migrant at Cleveland, Ohio. About half the nesting males are resident, about half migrate. Of the females, only a tenth to a third are resident. A few individuals of both sexes changed status in different years. There was no evidence that the males with the larger territories, more vigorous song or brighter plumage, were more successful than their fellows in obtaining mates. There is not, apparently, a reservoir of unmated birds of either sex to fill gaps due to mortality in the breeding season. The influence of warm waves of temperature on the commencement of song, migration and egg-laying is observed, and graphs show that the temperature-threshold at which each occurs is different at different times of year. Young often settled near their parents' territories, of which detailed genealogies are given, and one brother and sister mated. There is a detailed analysis of nesting success and survival of young and adults, and in a discussion of population limitation the importance of local changes in the environment is stressed. Territorial behaviour is considered to prevent overcrowding. There is also detailed information on weight, eggs, feeding times and other aspects of the breeding biology, and one chapter discusses the habits of the parasitic cow-bird. This is an important monograph, and the Linnean Society of New York has rendered a real service to ornithology by publishing it at such a moderate price.

Pituitary Extracts and Gastric Ulcers

A SERIES of papers by Prof. E. C. Dodds, working with various collaborators (*Proc. Roy. Soc.*, B, **123**, 22; 1937), gives a full account of some interesting observations on the effect of extracts of pituitary on the stomach. It has been found that extracts of the posterior pituitary containing the pressor principle produce gastric ulcers when injected in large doses into various animals. This observation provides a new way of studying methods of treating gastric ulcers. The production of ulcers appears to be due to the fact that the extracts inhibit gastric secretion, whether this secretion is due to histamine, insulin, sham feeding or pilocarpine. The action is primarily on the volume of the juice secreted. A continuous secretion of juice is probably necessary to protect the mucous membrane. A method is described for recording the gastric secretion and the blood flow simultaneously in an anæsthetized cat's stomach. Stimuli causing secretion induce increased blood flow and if the increase in blood flow is prevented, secretion does not occur. The injection of pituitary extracts inhibits both blood flow and secretion. In normal animals blood flow and secretion are closely co-ordinated, but after hypophysectomy this co-ordination disappears. The possible significance of these results is widened by the observation that pituitary extracts have a similar action on pancreatic secretion. These facts are possibly related to the action of these extracts on the excretion of urine.

Early History of the Potato

DR. R. N. SALAMAN delivered the Masters Lectures of the Royal Horticultural Society last autumn, on "The Potato in its Early Home and its Introduction into Europe" (*J. Roy. Hort. Soc.*, **62**, Parts 2, 3, 4 and 6; 1937). A mass of archæological material has been marshalled to show that the potato was cultivated in South America at least so early as A.D. 200. Many representations of the tuber as a motif for the pottery of several epochs of South American history are illustrated, and show that the life of the Indian was closely linked with this plant.

Dr. Salaman also shows that the potato satisfied the conditions demanded by the physical setting of the Inca civilization, and provided a supply of food where the cereal grains failed. He agrees with Vavilov, Bukasov and other Russian investigators, that potato cultivation originated in two distinct areas—in the plateaux of Peru and Bolivia, and in Chile and the island of Chiloe. The Russians believe, on botanical grounds, that the southern focus of development supplied the ancestry of our present-day 'Irish' potato; but Dr. Salaman, using arguments provided by history, believes that the Peru-Bolivian source is much more likely. The potato entered Europe by two channels, namely, by way of England, and via Spain. Introduction into England, according to Dr. Salaman, cannot be readily dissociated from the names of Drake and Raleigh, in spite of the modern tendency to deprive these gentlemen of the honourable place in horticulture which tradition assigns to them. Dr. Salaman has ante-dated the first record of potato culture in Europe by fifteen years, with his proof that tubers were grown in the neighbourhood of Seville in 1572. He has also established the documented history of the crop for a very early period.

Fault-movements and the Safety of Reservoir Dams

IN searching for reservoir sites among the coast ranges of California, engineers have found the most satisfactory features in certain fault-line valleys. The major faults of the district—the San Andreas, Hayward and Calaveras faults—have made possible the development of longitudinal valleys along parts of their courses, valleys so narrow that they can be closed by dams of moderate length. Dams have, indeed, been made across each of the three faults mentioned, and the question has been asked: Can a safe dam be built in a fault-line valley of a presumably active fault? Mr. G. D. Louderback has endeavoured to answer the question and to state the conditions that should be satisfied in their construction (*Bull. Seis. Soc. America*, **27**, 1–27; 1937). He shows how the activity of a fault may be determined by mapping the epicentres of recurring small earthquakes, and the map given of the three faults with the centres of the earthquakes of the years 1932–35 clustered along a great part of the course of each, reveals that they are all definitely active faults. The experience of past earthquakes makes it clear that provision must be made for a horizontal displacement of 15–20 ft. and a vertical one of 5–10 ft. The dam should therefore be 60 ft. wide at the crest with slopes of about 2 : 1. To avoid fracture, outlet pipes should be laid parallel to the active fault. Lastly, the dam and all its subsidiary structures should be built so as to resist a strong shock and also the effects of slumping and landsliding.

A Coefficient of Humidity

AMONG the series of papers of the State Meteorological and Hydrological Institute of Sweden is one (No. 11) entitled "A Coefficient of Humidity of General Applicability", by Anders Angström, which sets out certain ideas that were first discussed at the 1936 meeting at Edinburgh of the Union for Geodesy and Geophysics. The author points out the desirability of having some function which will indicate the humidity or aridity of any climate in respect of the soil, that is, which will take into account both the rainfall and the evaporation. A function of this kind was used by Lang in 1920, who took simply the ratio of the annual precipitation to the sum of the mean temperatures of the frost-free months divided by twelve, while Martonne in 1926 took the ratio of the annual precipitation to $10 + T$, where T is the annual mean temperature (in each of these two cases temperature is measured in centigrade). Angström suggests an alternative function, having the advantage over the two cited that it is a continuous function of temperature and can be used in the study of arctic climates. It is represented by the expression $1{\cdot}07^{t}$, where t is the mean temperature. He finds that this function is closely proportional to the mean duration of precipitation for a month if the latter is measured in hundreds of minutes, and that it is very nearly equal to the humidity function of Martonne for monthly mean temperatures between 0° C. and 20° C. A table is given which enables the new function to be read off quickly in terms of t, and two maps show its distribution in January and July over north-west Europe and adjacent polar regions, including Iceland, Greenland and Spitsbergen.

Monomolecular Films

THE study of the orientation of the molecules in monomolecular films has become of such importance that Messrs. E. Havinga and J. de Wael, of the van 't Hoff laboratory of the University of Utrecht, have worked out a technique for the production and investigation of such films by electron diffraction methods, and have published an account of it in the issue of March 15 of *Recueil des Travaux chimiques des Pays-Bas*. The film in the case described was of barium stearate prepared on the clean surface of water and floated by lowering the water slowly on to a thin solid film of nitro-cellulose or of gold leaf placed below the surface of the water. The film of nitro-cellulose itself was prepared by placing a drop of a solution of nitro-cellulose in amyl acetate on a clean water surface. On evaporation of the solvent, a film of about 300 A. thick was produced. An electron tube producing electrons of about 40 kilovolts path was used, and it was found that in addition to the diffraction pattern due to the support, in each case a hexagonal pattern of spots was produced which is attributed to the barium stearite film. Full details of the most suitable technique are given.

Two Visual Binary Orbits

DR. R. v. D. R. WOOLLEY and L. S. T. Symms have recently published a paper in which they discuss the orbits of O Σ 38 (γ_2 Andromedæ) and β 101 9 Argus (*Mon. Not. Roy. Astro. Soc.*, **97**, 6; April 1937). Both stars have completed at least one revolution, so that the periods can be determined with considerable accuracy. Orbits have been already published, and those given by the authors have been obtained by applying differential corrections to previous orbits. A description of the method for applying these corrections is given in each case. The ephemeris for the first binary shows a very small separation near periastron, and micrometer measures here would be useless. It is suggested that an interferometer might be used in 1946–47 when the separation is 0″·02–0″·03, as the star is bright. The period is 56 years (a year greater than the period found by Hussey), the eccentricity and inclination being 0·92 and 109·2° respectively. In the case of β 101, the eccentricity and inclination are also high, the values being 0·69 and 77·8° respectively. The period of this binary is 23·18 years.

Growth Factors

A DISCUSSION meeting on "Growth Factors" took place at the Royal Society on Thursday, June 24. The discussion revealed the emergence of a line of biochemical application which hitherto has been obscured by the diversity of its interest.

For a number of years, sporadic reports have been published by workers in the fermentation industries and bacteriology that the growth of yeast and bacteria depends not only on the provision in the diet of gross sources of energy and nitrogen, but also upon illusive materials—'bios', 'accessory growth factors', akin to the 'vitamins', responsible for the functioning of special phases of animal metabolism or even for the growth of animals. More recently, these tentative findings have been reinforced by workers in other specialized fields, for example, in botany and protozoology, and, by the use of modern biochemical technique and knowledge, it would now appear that the case established in the nutrition of animals is equally established in the nutrition of the most diverse varieties of cells ; namely, that all cells from the lowliest bacterium to the cells of the highest animals are enabled to carry out the series of reactions between the sources of energy and nitrogen, which result in the production of energy and growth, only by the agency of other substances mostly of a nature akin to those already described in animal metabolism—vitamins. The only notable difference between the various forms of life is that these accessory substances are normally synthesized by some cells but not by others, and thus in the former case these substances need not be supplied in the nutrient diet.

The proceedings were opened by Prof. F. Kögl, of Utrecht, with a review of the present state of knowledge of the plant hormones, auxin *-a* and *-b* and heteroauxin (β-indolylacetic acid). The auxins were first thought to exert their effect on cell elongation, but now it is recognized that they regulate plant growth in many ways. Auxin-*a*, for example, is thought to account for the phenomenon of phototropism. Auxin-*a* lactone loses its activity under the action of ultra-violet light, and thus the shaded side, containing a greater concentration of activity, would elongate and produce the effect of phototropism. The action of heteroauxin seems to be primarily associated with the formation of roots on stem cuttings. This action is, however, not dependent on chemical structure, since a number of unrelated substances have a similar effect, recalling the non-specificity of œstrogenic compounds described by Dodds and co-workers.

Prof. Kögl also gave an account of his 'biotin', a sulphur-containing substance of great potency which may be the chief component of 'bios', originally described by Wildiers as a necessary growth factor for yeast. Biotin has also been shown to have an effect on the growth of higher plants.

Dr. P. Fildes (London) reviewed the subject as it appears to the medical bacteriologist, tracing the evolution of the vitamin concept for bacteria from Twort and Ingram's growth factor for Johne's bacillus (1912) to the present time, when vitamin B_1 has been proved to be essential for *Staphylococcus* and propionic acid bacteria, and nicotinic acid or cozymase for *Staphylococcus* and the influenza bacillus. He laid stress on the facility with which bacteria can adapt themselves to altered nutritional conditions, and ascribed the fact that parasitic bacteria specially require growth factors to a loss of synthetic function which has resulted from long association with an environment in which these factors are preformed. These dependent bacteria can readily be trained back to their 'original' state, in which they can synthesize the factors and so do not require to be supplied with them. In a series of different species of bacteria, each ultimately requiring cozymase for growth, it was shown that the complexity of the nutrients from which cozymase can be synthesized depends upon the synthetic power of the bacteria at the time of examination.

M. André Lwoff (Institut Pasteur, Paris) pointed out that certain bacteria and Protozoa cannot grow without a supply of hæmin, because they are unable to synthesize it from iron compounds in the nutrients. The importance of hæmin is ascribed to its function as a stage in the synthesis of cytochrome in Keilin's system. Its effect is to increase greatly the oxygen consumption of organisms starved of it.

M. and Mme. Lwoff have demonstrated that the long-known 'vitamin factor' of the influenza bacillus is none other than Harden and Young's cozymase or Warburg's co-enzyme. Metabolic studies have shown that cozymase acts as a codehydrogenase for various substrates and much increases the oxygen uptake of influenza bacilli and anaerobic glycolysis. Both hæmin and cozymase function as bacterial growth factors as components of the dehydrogenase-cytochrome system of Keilin and Warburg.

Mr. B. C. J. C. Knight (London) gave an account of the *Staphylococcus* and *Sporogenes* factors referred to by Dr. Fildes. He showed that the former consists of nicotinic acid, a constituent of cozymase and of the two halves of the vitamin B_1 molecule—the pyrimidine and thiazole rings. The activity of each compound depends strictly on certain chemical configurations. The *Sporogenes* factor has not been finally determined, but there is evidence that it may have a much wider importance than merely the regulation of the metabolism of the obligate anaerobes.

Dr. G. M. Richardson (London) described uracil, a component of nucleic acid, as an essential factor in the anaerobic growth of *Staphylococcus*. Uracil is synthesized by the organism aerobically, and therefore under these conditions its effect on growth cannot be demonstrated. Anaerobically, however, the synthetic power of the organism is sufficiently depressed to make the demonstration possible. No metabolic function has hitherto been ascribed to uracil.

In the discussion which followed the more formal proceedings, there appeared to be complete agreement between the various speakers not only in detail but also in the wider implications of the discussion. Dr. E. R. Holiday (London) referred to the demonstration of nicotinic acid in Knight's crude *Staphylococcus* factor by means of absorption spectra. M. Lwoff recalled other factors which have been found by his colleagues in the Pasteur Institute, namely, the forms of sulphur necessary for the growth of certain fungi (Volkonsky) and the sterols found by Mlle. Cailleau to be necessary for flagellates.

A Method of Determining Stellar Rotation*

WHILE rotational speeds of stars can be estimated from photographs of stellar spectra, the actual deduction of these speeds and the demonstration that the star is rotating depend on rather abstruse mathematical calculation which, however, leads to a comparatively simple working routine. A knowledge of stellar rotational speeds, while obviously worth determining in any event, has several immediate applications, such as assessing the age of the stellar system, and is especially important in discussing the state of affairs in stellar atmospheres, a high rotational speed tending to offset gravity and promote ionization. If the rotational speed of a star is determinable, then the 'proper' spectrum of the star can be deduced; that is, the light emitted by any element of the star's surface, as distinct from the 'integrated' spectrum directly observed. Owing to the minuteness of a stellar image in a telescope, the light from the whole of the star's surface passes into the spectroscope, and the rotational speed of a star cannot be measured as can that of the sun by observing the Doppler displacement of the Fraunhofer lines from one limb as compared with the other.

Prof. Carroll's method depends on the fact that the observed shape of a stellar absorption line (that is, the graph of intensity plotted against wavelength) has certain peculiarities if the star is rotating.

If a star be rotating, then different elements of area on the surface of the star are moving towards or away from the observer with velocities in the line of sight which depend on their position on the stellar surface and the rotational speed of the star. Thus, the spectra from the different elements do not simply superpose, as they would in a non-rotating star, but are displaced somewhat with respect to each other, thus resulting in a shallow broadened line. The final observed line shape therefore depends on two factors, namely, (*a*) the shape of the line emitted by any element of the star and (*b*) the rotational displacement. The first factor is quite unknown—previous methods of estimating stellar rotational speeds, however, depended on assuming this to be known—but the second factor can be detected by the new method.

The equations connecting the 'proper' shape $\mathfrak{J}(\mathfrak{T})$ of a line and the observed shape $\mathfrak{O}(\mathfrak{T})$ are

$$\mathfrak{O}(\mathfrak{T}) = \frac{1}{a}\int_{-1}^{+1} \mathfrak{J}(\mathfrak{T} + \beta t)\, g(t)\, dt$$

where a is a numerical factor and equal to $\int_{-1}^{+1} g(t)dt$, and $g(t)$ is a function that depends on the way the brightness of the star varies over its disk, and β is the rotational speed of the star.

The solution of this equation is[1]:

$$\mathfrak{J}(\mathfrak{T}) = \frac{1}{2\pi\iota}\int_0^\infty \frac{e^{-ux}}{G(\beta x)}\int_c \mathfrak{O}(z)e^{-zx}dzdx,$$

where $$G(u) = \frac{1}{a}\int_{-1}^{+1} e^{-ut}\, g(t)dt\,;$$

but this is unusable as it stands as $\mathfrak{O}(z)$ is to be integrated over a certain contour in the complex domain and $\mathfrak{O}(z)$ is only known for real values of z. Analytical investigation shows a simple way out. We form the real part of the Fourier transform of $\mathfrak{O}(\mathfrak{T})$, namely, $f(u) = \int_{-\infty}^{\infty} \mathfrak{O}(\mathfrak{T}) \cos u\mathfrak{T}\, d\mathfrak{T}$, which is easily done and plotted as a graph of $f(u)$ against u. It appears that, if the star be rotating, $f(u)$ must vanish (have zeros) at certain values of the product $u\beta$. Now we find, by plotting $f(u)$, the values of u for which $f(u)$ vanishes and hence by simple division the value of β.

It is, of course, possible for $f(u)$ to vanish for other reasons; the importance of the method lies in the fact that, if $f(u)$ has several zeros, they must give (or some of them), if the star is rotating, consistent values of β. A further test is that the values of β from different lines must be the same. Thus, if several zeros from several lines all yield substantially the same value for β, we can feel with some confidence that the observed line shapes are really produced by rotational broadening. As the theoretically calculated values of $u\beta$ for which $f(u)$ vanishes depend somewhat on the law of darkening involved in $g(t)$, it is theoretically possible to test this law as well. Having found β, a further simple computation (forming $\mathfrak{J}(\mathfrak{T})$ from its transform) yields the 'proper' shape of the emitted line.

A similar method can be applied to the problem of stellar expansion.

In interpretation of this procedure, it was explained that any arbitrary function of the type considered might be represented by a 'spectrum' of harmonic constituents (Fourier's integral theorem), the result obtained meaning that, if the observed line shape is due to rotation, certain of these harmonic constituents must necessarily be absent. Practical tests for this give the information (*a*) whether the star is rotating, (*b*) the speed of rotation, that is, the equatorial velocity in the line of sight, and (*c*) thus enabling the 'proper' shape of the lines in the stellar spectrum to be found.

Unfortunately, the lines to be examined are, if the rotational speed be high enough to be readily determinable, wide, faint, shallow lines, and the technique of stellar photographic spectrophotometry is strained to the uttermost in providing sufficiently accurate measurements of line shape. Prof. F. J. M. Stratton, of the Solar Physics Observatory, Cambridge, is collaborating with the Natural Philosophy Department of the University of Aberdeen in attempting to produce sufficiently good observations, and very promising results are now being obtained.

In the case of one star, namely, Algol, independent measurements of rotational speed are available, and the direct measurements give 26 km./sec. as the equatorial line of sight velocity for this star, compared to 26 ± 3 km./sec. determined by Prof. Carroll's method, using an exceptionally well determined profile of the line Mg^+ at 4481A. obtained by Struve at Yerkes Observatory.

* Summary of a lecture on "Rotating Stars" delivered before the Newcastle-upon-Tyne Astronomical Society at Armstrong College, on March 11, by Prof. J. A. Carroll.

[1] *Mon. Not. Roy. Ast. Soc.*, **93**. 478, 508, 680 (1933).

Aluminium Manufacture in Great Britain

WITH the exception of silicon, aluminium is probably the most abundant metal in the world, forming nearly one eighth of the earth's crust. Owing to the ready manner with which it combines with oxygen, it is never found, as most other metals are, in the metallic state. In a paper in the 'Aluminium Section' of the March issue of the "Trade and Engineering Supplement" of *The Times*, Mr. W. Murray Morrison gives an outline of the position which the aluminium industry now occupies in the British Isles.

In 1921, the Lochaber Power Co. was formed and developed a large water-power station. When completed, this scheme will be capable of developing 100,000 h.p. continuously, and will be by far the largest hydro-electric development in Great Britain. The British Aluminium Co. operates three reduction works, at Foyers, Kinlochleven and Lochaber. These are supplied with pure aluminium oxide from their works at Larne in Ireland and Burntisland in Scotland. These works in turn are supplied with crude ore, bauxite, from the Company's own mines, vast deposits being owned by it in the south of France and in some British colonies. There is one other producer of the crude metal in Great Britain, namely, the Aluminium Corporation, the supplies of alumina for which are produced at Hebburn-on-Tyne and reduced to the metal at Dolgarrog, North Wales.

The final forms in which aluminium reaches the public cover a very wide field. The two forms in which it is best known are for cooking utensils and foil. The advantages of aluminium vessels for cooking are their lightness, cleanliness, hygienic qualities and heat conductivity, together with their immunity from chipping, rusting and burning; these properties have made them very popular. Aluminium foil has almost entirely replaced other kinds of metal foil and is adopted for the wrapping of cigarettes and chocolates, the capping of milk bottles and tea-chest linings.

In connexion with motor-cars, aluminium pistons are now very commonly employed. Aluminium, which is only one third the weight of iron or copper, made possible the remarkable increase in the speed of transport which has taken place during the last fifty years. Motor-vehicle owners are keenly alive to the fact that it costs a given sum to convey a given weight a given distance in a given time. There is an additional advantage of using aluminium in road vehicles, as the increased lightness sometimes saves an appreciable part of the motor tax in Great Britain and allows the vehicle to run at a higher speed.

In air transport, where lightness is a paramount consideration, aluminium and its alloys play a very important part. Only one metal lighter than aluminium, namely, magnesium, is used as the major constituent in the manufacture of light alloys. The production of magnesium is closely allied to the aluminium industry. For these two metals and their alloys the aircraft industry depends for many of its components.

In electrical transmission, aluminium has been most useful. In Great Britain, the transmission lines of the National Grid alone employ more than 20,000 miles of steel-cored aluminium cable.

Association for the Study of Systematics in Relation to General Biology

AN opening meeting of the "Association for the Study of Systematics in Relation to General Biology" was held in the rooms of the Linnean Society (by kind permission of the president and council) on Friday, June 25. The chairman of the Association, Dr. Julian Huxley, presided over a gathering of seventy-four biologists.

In his introductory remarks, Dr. Huxley outlined the history of the Association. He said that the movement commenced with informal meetings in the autumn of 1936 between certain members of the staff of the Royal Botanic Gardens, Kew, and the John Innes Horticultural Institution at Merton. These led to the formation, on May 3, 1937, of a joint zoological and botanical "Committee on Systematics in Relation to General Biology". This committee eventually changed its title to the present form, and a council and seven committees were elected. The council at present consists of the following biologists: J. S. Huxley (*chairman* of the Association), H. W. Parker (*zoological secretary*), J. S. L. Gilmour (*botanical secretary*), W. T. Calman, G. S. Carter, M. B. Crane, C.D. Darlington, C. Diver, E. B. Ford, R. Ruggles Gates, H. Godwin, J. W. Gregor, M. A. C. Hinton, J. R. Norman, J. Ramsbottom, O. W. Richards, N. D. Riley, E. J. Salisbury, Miss B. Schafer, T. A. Sprague, W. B. Turrill, B. P. Uvarov, E. B. Worthington, Sir W. Wright-Smith.

Dr. Huxley then explained the aims of the Association, which may be summarized under the following heads:

(1) To examine the theoretical and historical bases and the practical aims of taxonomy, and especially the relation of phylogeny to cytogenetic and taxonomic data.

(2) To examine the criteria employed in defining species and other systematic categories in different groups and the possibility of obtaining greater uniformity in their usage.

(3) To consider how far in the light of cytogenetic, ecological, physiological, embryological, and palæontological data, existing classification might require to be modified and new subsidiary terminology to be introduced. Further, to investigate the relation of any such subsidiary terminology to the International Rules of Nomenclature.

(4) To investigate the data and material already available, either taxonomic or bearing on taxonomy, with the view of correlating them with general biological principles and of establishing generalizations in comparative systematics.

(5) To press for the appointment of additional taxonomists and other biologists to the staffs of museums and other appropriate institutions.

(6) To arrange for research into the relative importance of the various factors, internal and external, operative in different groups in producing speciation and other evolutionary processes.

(7) To co-operate in the production or improvement of handbooks on British animals and plants and in the eventual publication of a British Fauna and Flora on uniform biological lines.

(8) To suggest useful lines of biological work to natural history societies and to amateurs and to assist in its co-ordination.

(9) To investigate the best methods of teaching systematics and field work in universities and schools.

(10) To stimulate discussion and to promote co-operation between workers in different branches of biology on problems of taxonomic interest.

The committees so far formed, together with the particular items of the aims of the Association with which they are concerned, are as follows :

(1) Taxonomic principles (items 1–3). Convener : Mr. J. S. L. Gilmour, Royal Botanic Gardens, Kew.

(2) Comparative systematics (item 4). Convener : Mr. J. R. Norman, British Museum (Natural History), Cromwell Road, S.W.7.

(3) Research (item 6). Convener : Dr. W. B. Turrill, Royal Botanic Gardens, Kew.

(4) Handbooks (item 7). Conveners : Captain C. Diver, 40 Pembroke Square, W.8 ; Mr. M. B. Crane, John Innes Horticultural Institution, Merton, S.W.19.

(5) Natural History Societies (item 8). Convener : Mr. H. W. Parker, British Museum (Natural History), Cromwell Road, S.W.7.

(6) Education (item 9). Convener : Miss B. Schafer, John Innes Horticultural Institution, Merton, S.W.19.

(7) Publications (other than handbooks). Convener : Dr. C. D. Darlington, John Innes Horticultural Institution, Merton, S.W.19.

At the close of the meeting, fifty-three biologists, in addition to the existing council and committees, gave in their names as members. Any other biologists wishing to join the Association should send their names and addresses to one of the secretaries, stating in which particular committee they are interested. For the present there is no subscription or formal method of election.

Annual Conference of the Museums Association

THE forty-eighth annual conference of the Museums Association was held in Newcastle-upon-Tyne in the week commencing July 5. The chief impression which one gained from the Conference was that museum officials are considering their problems in a new and more critical manner.

The keynote was set by Alderman Charles Squire in his presidential address. As chairman of the Leicester Museums Committee for the past twenty-seven years, he could speak with authority, and did not hesitate to criticize the general failure of municipal councils to make adequate provision for their museums. Museums and art galleries have a high place in the educational and social scheme, and are not yet getting the support which they deserve. Alderman Squire also referred to the valuable work that could be done by museums in assisting to preserve local records and the amenities of the countryside.

Another critical paper was one by Dr. W. E. Swinton (British Museum, Natural History), on "Natural History Museums and the Community". Too many small natural history museums might have as their motto "How best to kill a love of Nature", and Dr. Swinton strongly advocated the elimination of useless material and better display of the collections, so that these might inspire the visitor with a greater interest in plants, animals and rocks in their natural settings. The paper dealt with many other points of practical importance, especially the need for having as curator one who was not only a scientific worker, but also a man of action.

In the same general field there was also a valuable discussion on "Simplifying Habitat Groups", to which Mr. R. K. Perry (Liverpool), Mr. T. Russell Goddard (Newcastle), Mr. W. E. Mayes (Leicester), and Mr. R. Wagstaffe (Stockport) contributed. It was pointed out that in a zoological exhibit it is most valuable to have an indication of the natural habitat of the birds or animals displayed, but that the elaborate group, to be found in the larger American museums, is far too expensive for the smaller English institutions. The proposals made were in the direction of suggesting habitat by branches of trees, by plants, or by other background material, and by the careful arrangement of the specimens in natural attitudes.

On the archæological side, current museum methods were again criticized, the speaker being Mr. Ian Richmond, of Armstrong College. Mr. Richmond answered the question : "What does an archæologist expect of a museum ?" He suggested that the museum should contain a full series of local maps, especially those showing human distribution at different epochs ; that one exhibit at least should display all the objects and clues that had been obtained from a single excavation ; and that, wherever possible, comparative series of exhibits should be set up. He also appealed for a simple classified system of storage of all material not on exhibition.

Within the scientific field there were some important papers of a descriptive nature. Thus, Col. E. E. B. Mackintosh, director of the Science Museum, described the special exhibitions which have been developed at that Museum since 1911. It is interesting to learn that these very successful displays, which in recent years have covered such subjects as refrigeration, rubber, electro-deposition, noise and smoke abatement, electric illumination and television, take from six to twelve months to prepare, and that

the cost of the exhibitions has varied from less than £50 to more than £3,000 (the latter cost being borne by the industry concerned).

In his account of the Hancock Museum, Mr. T. Russell Goddard explained that this institution is financed entirely by the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne. It was characteristic of the scientific life of the past century that so much public service had been performed by voluntary effort; but at the present time the finances of the Society are scarcely adequate to maintain the Museum in an effective manner.

Lastly, a valuable account was given by Dr. Kathleen B. Blackburn (Armstrong College) on modern methods of pollen analysis in relation to archæological finds from peat. Mr. H. A. Hyde (National Museum of Wales, Cardiff) also dealt with this subject, and stressed its importance to the museum curator.

On the art side, Dr. John Rothenstein, director of the City Art Galleries, Sheffield, described the work which is being done in his Galleries to give school-children a greater perception and understanding of contemporary art (especially in the form of household objects), while Mr. Richard Bach, of the Metropolitan Museum of Art, discussed the vigorous way in which art collections are brought to the people in New York by the Museum's "Neighbourhood Circulating Exhibitions".

In general discussions the problem of bad museums was considered more than once, and Mr. S. F. Markham (Hon. Empire Secretary, The Museums Association), after carefully defining such museums, advocated that steps should be taken to close them. Dr. C. Hay Murray, in a paper on "Museums as Department Stores", suggested that the curator should regard himself as a salesman, and study the methods of the shopkeeper. No less important, but of a more domestic nature, were papers by Mr. Laurence Vail Coleman, director of the American Association of Museums, on "The Philosophy of a Museums Association", and by Mr. S. D. Cleveland (Manchester) on "The Future of the Museums Association". Judging from the keen interest which the Conference aroused, that future will be an active and successful one.

The next Conference of the Association (of which the headquarters are at Chaucer House, London, W.C.1) will be held at Belfast in the first week of July 1938.

Flight in the Stratosphere

ALL countries which are interested in aviation have been considering the possibility of extending their activities to aircraft in the stratosphere. The greatest advantage in flying very high is that much higher speeds can be obtained for the same expenditure of power as the density of air is so much lower in the stratosphere than at ground-level. The Schneider trophy was won, for example, at a speed of 430 m.p.h. with an engine which gave 2,200 h.p. In the stratosphere, a speed of about 800 m.p.h. could be obtained for the same power. To drive the Schneider trophy winner at the latter speed near the ground would require an engine of 30,000 h.p. If stratosphere flight were possible at 600 m.p.h., then New York would be only five hours from London; so that by local time a passenger from London would arrive at New York before he started.

In vol. 7 of the Cambridge University Engineers' Association Year book recently published, Captain J. L. Pritchard points out some of the difficulties involved in flying in the stratosphere, and concludes that these will probably prevent stratosphere flight becoming a regular service, at least in the present generation. In fact, the increasing engine temperatures due to the difficulty of getting greater cooling may make regular flights in the stratosphere impossible until a new source of power is discovered.

The output of the internal combustion engine can only be maintained if the weight of oxygen it takes in per minute is maintained constant. At an altitude of 60,000 feet, the density of air is only about a tenth of what it is at ground-level. To maintain its output the engine would have to run ten times faster than at ground-level or take in ten times the volume of air.

The former alternative is impracticable so the weight of the air would have to be kept constant by supercharging. During this process, the pressure of the air is raised to about that at ground-level and the temperature by about 300° F. As most of the heat given in the air supplied has to be dissipated, extra cooling is necessary. Despite its low temperature, the low pressure of the atmosphere at this height is a disadvantage. Supercharging requires greater weight of equipment; in fact, the higher the aeroplane the greater its requisite weight.

In 1931, Prof. Picard discovered another fact which increases the difficulties of arranging for cooling. He found that at a height of ten miles, the temperature outside his gondola was −67° F., whilst inside the temperature was 140° F. This was due to the radiant heat absorbed by the gondola. As a method of getting over these difficulties the rocket principle has been suggested. This doubtless would work better at low temperatures than at the ones at which it has been tried. It has to be remembered also that the velocity of sound in the stratosphere is about 700 m.p.h., a speed which enthusiasts think aircraft might attain. Some engineers think that the aeroplane will have a critical speed at this speed, but it is not known how it would get through this critical speed. For this speed, the aeroplane would probably require small wings and the landing speed might have to be about 130 m.p.h.

As an offset to these disadvantages, there would be a great saving of fuel for the journey and the time would be much shorter. In the event also of an emergency landing, there would be a much greater choice of landing grounds, as it would be possible to travel 140 miles with the engine cut off by gliding from a high altitude.

University Events

BELFAST.—In connexion with the annual meeting of the British Medical Association recently held in Belfast, the following honorary degrees have been conferred: *doctor of laws:* Dr. G. C. Anderson, medical secretary of the British Medical Association; Sir E. Farquhar Buzzard, professor of medicine in the University of Oxford, physician to His Majesty the King, and president of the British Medical Association; Dr. H. Morley Fletcher, consulting physician at St. Bartholomew's Hospital and former president of the Association of Physicians; Prof. E. W. H. Groves, emeritus professor of surgery of the University of Bristol: *doctor of science:* Prof. S. P. Bedson, professor of bacteriology in the University of London; Dr. A. Felix, of the Lister Institute, known for his researches on typhus and enteric fevers.

CAMBRIDGE.—The Frank Smart studentship in botany will be vacant on October 1, 1937. Any graduate of the University is eligible for the studentship, which is valued at £210 a year. Further information can be obtained from Prof. F. T. Brooks, at the Botany School.

The Benn W. Levy research studentship in biochemistry will become vacant on October 1. Applications for its tenure should be addressed to Sir F. Gowland Hopkins at the School of Biochemistry before July 24.

LEEDS.—The Clive Behrens lectureship has been instituted by means of an endowment of £1,000 given by the Hon. Mrs. Behrens. The lecturer will be appointed biennially to give a series of four, five or six lectures on a subject germane, and of importance, to the practice of agriculture.

LONDON.—Mr. A. A. Miles has been appointed, as from October 1, to the University chair of bacteriology tenable at the University College Hospital Medical School. Since 1934 he has been University reader in bacteriology at the British Postgraduate Medical School.

Prof. J. H. Dible has been appointed, as from October 1, to the University chair of pathology tenable at the British Postgraduate Medical School. Since 1929 he has held the George Holt chair of pathology in the University of Liverpool.

OXFORD.—E. H. Leach, Oriel College, has been appointed to the new lectureship in physiology on the foundation of William Hulme at Brasenose College.

M. S. Wills, University College, has been awarded the Scott scholarship in physics for two years from October 1.

F. G. W. Knowles, Oriel College, has been elected to the Naples biological scholarship for the year 1937–8.

F. Fulton, Pembroke College, has been awarded the Radcliffe scholarship in pharmacology.

A special number of the *University Gazette* has been issued containing notices of the scholarships and exhibitions announced for the year 1937–8 by the men's colleges. In all, there are about 210 scholarships and 105 exhibitions open for competition. Of these, 37 and 16 are to be awarded for natural science, 13 and 6 for mathematics, 6 and 2 for either natural science or mathematics, and 8 and 5 for any of five subjects of which natural science and mathematics are two.

Science News a Century Ago

A Fatal Parachute Descent

IN Airy's "Autobiography" in the notes on the events of 1837 is one stating, "On July 24th I saw the descent of the parachute by which Mr. Cocking was killed. I attended the coroner's inquest and gave evidence a few days later". Robert Cocking was a landscape painter, who in his earlier days had been a member of the City Philosophical Society with which Faraday was connected. In August 1814, he had lectured to the Society on aeronautics and had received a medal from the Society of Arts. In 183 he made a curious form of parachute like an inverted truncated cone, 34 ft. in diameter at the top, which was formed of a circular metal tube 2 in. in diameter. A wooden hoop 3–4 ft. in diameter formed the lower edge, and between the hoop and tube was stretched strong linen. It weighed about 150 lb. Being most anxious to try it, he prevailed upon Green, an aeronaut, to ascend in a balloon from the Vauxhall Gardens on the evening of July 24, with Cocking and his parachute suspended beneath the balloon. Having travelled as far as Lee, Cocking released himself, the parachute collapsed and he was killed.

The inquest was held at the Tiger's Head, Lee and attracted a great deal of notice. Airy had watched the balloon through a telescope, and he and other scientific men gave evidence at the inquest. Green, in his evidence, said that he had an unconquerable objection to parachutes which he considered quite useless and not likely to lead to any good end. In the course of the inquest, Faraday's name was mentioned as having spoken with Cocking at the Gardens before the ascent, and on July 31, Faraday wrote a letter to *The Times* in which he referred to the lecture of Cocking, and his recollection of the inventor's "companionship, abilities and kindliness". The verdict at the inquest was that, "We find that the deceased Robert Cocking, came to his death casually and by misfortune, in consequence of several injuries received by a fall out of a parachute of his own invention and contrivance, which had been appended to a balloon; and we further find that the parachute did move to his death, and therefore that such parachute ought to become a deodand and forfeited to the Queen". Cocking, who was sixty-one years of age, was buried in a grave next to that of Halley and Pond at Lee.

Telegraphic Communication on Railways

WHEN Wheatstone and Cooke patented the electric telegraph, Robert Stephenson and the directors of the London and Birmingham Railway sanctioned the laying of wires between the Euston Square and Camden Town stations. Towards the end of July 1837, the telegraph was ready and Dr. Andrew Wynter in his "Curiosities of Civilisation" said: "Late in the evening of the 25th of the month, in a dingy little room near the booking-office at Euston Square, by the light of a flaring dip-candle which only illuminated the surrounding darkness, sat the inventor, with a beating pulse, and a heart full of hope. In an equally small room at the Camden Town station, where the wires terminated, sat Mr. Cooke, his co-patentee, and among others, two witnesses well known to fame—Mr. Charles Fox and Mr. Stephenson. . . . Mr. Cooke in his turn touched the keys and returned the answer. 'Never did I feel

such a tumultuous sensation before,' said the Professor, 'as when all alone in the still room I heard the needles click ; and as I spelled the words, I felt all the magnitude of the invention, now proved to be practical beyond cavil or dispute.' The telegraph thenceforward, as far as its mechanism was concerned, went on without a check, and the modifications of the instrument, which is still in use, have been made for the purpose of rendering it more economical in its construction and working, two wires at present being employed, and in some cases only one."

Artificial Digestion

THE *British and Foreign Medical Review* of July 1837 contains the following information : "Dr. T. J. Todd of Brighton with the assistance of Mr. Schweitzer of the German Spa, Brighton, has been performing experiments with the artificial digestive fluid, in imitation of those of Schwann in Berlin and has arrived at some new and interesting results not attained by Dr. Schwann. The digestive fluids with which Dr. Todd operated were prepared from the stomachs of the ox, the horse, the dog and the cat. Some, also, prepared from the upper portion of the small intestines, was found not less powerful. The presence of the acid is essentially necessary in the preparation ; when Mr. Schweitzer endeavoured to procure the digestive fluid with distilled water alone, or when he treated the mucous membrane in the same way with a weak alkaline solution, a rapid putridity stopped all further proceedings. Various animal and vegetable substances were submitted to the action of these digestive fluids, at the ordinary temperature of the atmosphere, and the contact result in all the instances had been that these substances have been resolved into their elementary organic globules."

"There has been no exception to this, so far as the experiments have extended, and these include among vegetable substances the artificial digestion of boiled cauliflower, of bread, and of vermicelli, not dressed ; and among animal substances, the white of egg boiled, the coagulation of blood, butter, fat, the muscular fibre of mutton and of fish boiled and raw, filaments of the sciatic nerves raw, and scrapings of bone. The products of these artificial digestions especially of the vegetable substances compared with chyme taken from a dog which had been feeding upon ground oats, were very much alike, except that the watery part had been removed from the chyme."

Cure for Drunkenness

THE issue of the *Indian Journal of Medical and Physical Science* of July 1837 contains the following information : "A native of Norway, aged 40, who had from his youth been accustomed to dram drinking, was attacked with delirium tremens. His medical attendant to cure him of his dangerous propensity, prescribed the daily dose of a mixture of two drachms of sulphuric acid and twenty-four ounces of whisky. The result was remarkable. In three months' time he got such a dislike to all kinds of spirituous liquors that he could not bear to swallow a drop of anything stronger than beer. The dose of the above mixture taken, was four wine-glasses daily, and the cure had been of a year's standing at the time of the communication of the case."

Societies and Academies

Dublin

Royal Irish Academy, May 10.

W. J. MCCALLIEN : Structure of the Rathmullen District, Co. Donegal. An account is given of the Crana quartzite in the district between Rathmullen and Milford. It can be split into three divisions. The structure of the quartzite group is described, and emphasis is laid on the value of the epidiorite sills in the interpretation of the structure. The base of the quartzite is believed to be a slide, which is folded and overfolded. The Killygarvan limestone, which is younger than the Crana quartzite, is correlated with the Culdaff limestone.

Cape Town

Royal Society of South Africa, April 21.

Archæology of the Oakhurst Shelter, George. (1) A. J. H. Goodwin : Course of the excavation. A description of general methods of excavation, stratigraphy, and cultural remains as observed on six visits to the Oakhurst Shelter. (2) Disposition of skeletal material. An account of the graves, their cultural age and associations, positions of burial and grave furniture. (3) M. R. Drennan : The cave-dwellers. An anthropometrical and descriptive account of the adult population of the shelter. (4) Children of the cave-dwellers. An anthropometrical account of the child population of the shelter, stressing growth and development in relation to the adult group. (5) J. F. Schofield : The pottery. An account of the pottery found in the superficial deposits at Oakhurst shelter.

P. W. LAIDLER : An unusual grooved stone.

J. F. SCHOFIELD : Pottery from the Umgazana and Zigzag caves.

Cracow

Polish Academy of Science and Letters, April 5.

TH. BANACHIEWICZ : The inverse of a Cracovian, and a general solution of a system of linear equations.

W. JACYNA : The differences in the indications of gas thermometers. A helium thermometer at constant pressure gives higher readings than a helium thermometer with the gas at constant volume if the temperature is higher than $-100°$ C.

F. GORSKI : The polarimetric titration of the oxyacids. The author adds an excess of ammonium molybdate, to increase the rotatory power, and titrates with a standard solution of the optical isomer of opposite sign. Errors due to various secondary factors are thus eliminated.

MME. H. KRZEMIENIEWSKA and S. KRZEMIENIEWSKI : (1) The Myxobacteria—cellulose-degrading agents. Description of Myxobacteria, especially the family Sorangiaceæ, capable of living on cellulose in the presence of free oxygen. These bacteria can be grown on a synthetic medium containing cellulose and nitrates. (2) The degradation of cellulose by the Myxobacteria.

J. BADIAN : The cytology of yeasts.

W. NIESIOLOWSKI and R. WOJTUSIAK : The geographical extension of forms of the species *Erebia manto*, especially in the eastern Carpathians.

J. ZACWILICHOWSKI : Experimental researches on the behaviour of acquired characters in the descendants of *Lymantria dispar*.

B. HRYNIEWIECKI : Count Michel-Jérôme Leszczyc-Suminski, and his study of the development of ferns.

Moscow

Academy of Sciences, (*C.R.*, 14, No. 8; 1937.)

V. S. IGNATOVSKIJ: The Laplacean transformation (5).

P. KOROVKIN: A generalization of Taylor's series.

V. SOKOLOVSKIJ: Concerning a problem of the theory of shells.

N. STRELECKIJ: The factor of safety as an indicator of strength equality of structures.

E. P. OSTROVSKIJ: Generation of powerful sound vibrations by magnetostriction.

K. CH. KEKČEEV: Action of non-adequate stimuli on receptors.

A. E. FAVORSKIJ and M. D. BONE: Methods of determination of the constitution of carbohydrates of the series C_nH_{2n-2}.

P. SCHORIGIN and S. A. SKOBLINSKAJA: The decomposition of ethers (and esters) of cellulose by a solution of metallic sodium in liquid ammonia.

F. M. ŠEMIAKIN and A. I. LAZAREVA: (1) A study of periodic precipitation in aqueous media in capillaries, in the formation of barium carbonate, copper chromate and silver sulphate. (2) Comparative study of periodical precipitations in aqueous media by the Morse and the Ostwald methods.

L. G. DOBRUNOV: Characteristics of the growth and mineral nutrition of hemp with simultaneously maturing male and female plants.

N. V. MOROSOVA-VODJANITSKAJA: Some data on the vegative productivity of the Black Sea.

Rome

National Academy of the Lincei (*Atti*, 24, 323–392; 1936).

E. BOMPIANI: Projective invariants in the theory of surfaces (1). Rapid reconstruction of the theory of projective applicabilities.

L. TONELLI: Problem of Plateau (1).

N. ABRAMESCU: Study of a surface in the region of one of its points, and a new interpretation of the cubic given by the tangents of Darboux and Segre.

E. CASTELNUOVO: A class of rational surfaces which admit ∞^2 transformations projective in themselves.

A. ERDÉLYI: The generalization of a formula of Tricomi.

L. ROTH: Semi-rational varieties in three dimensions.

L. CESARI and F. CONFORTO: The equation of the three moments for a continuous bent beam stressed axially, with a bending rigidity which is variable linearly along each span (2).

L. LABOCCETTA: A more general form of Kepler's third law.

G. ARRIGHI: Isocarene oscillations about the configurations of general equilibrium.

R. MANZONI ANSIDEI: Raman spectrum of aromatic hydrocarbons with condensed nuclei (1). Anthracene and phenanthrene, and their molecular symmetry.

G. B. BONINO: Molecular symmetry of thiophene (2).

G. NATTA and R. RIGAMONTI: Electron diffraction examination of some vinyl polymers.

E. TRIA: Relation between temperature and activity of the glycogenolytic ferment in the liver of poikilotherm animals.

Appointments Vacant

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

PROFESSOR OF CIVIL ENGINEERING, IRRIGATION AND HYDRAULICS in the Thomason Civil Engineering College, Roorkee, United Provinces, India—High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (July 31).

HEAD OF THE DEPARTMENT OF ENGINEERING, ARCHITECTURE AND BUILDING of the Bradford Technical College—The Principal (July 31).

ASSISTANT ENGINEER in the Mechanical and Vehicle Engineering Section at the Headquarters of the Ministry of Transport—The Establishment Officer (July 31).

ASSISTANT CURATOR in the Rock Garden and Herbaceous Department of the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (August 3).

PERMANENT ASSISTANT (metallurgy) in the Admiralty Technical Pool—The Secretary of the Admiralty (C.E. Branch) (August 7).

PROFESSOR OF FORESTRY in the University of Aberdeen—The Secretary (November 1).

ASSISTANT LECTURER IN CIVIL ENGINEERING in the Imperial College of Science and Technology (City and Guilds College)—The Secretary.

TEACHER OF ENGINEERING in the Oldham Municipal Technical College—The Director of Education, Education Offices, Oldham.

LECTURER IN MATHEMATICS and LECTURER IN CHEMISTRY in the Kingston Technical College—The Principal.

LECTURER IN ENGINEERING in the Brighton Technical College—The Education Officer, Education Offices, 54 Old Steine, Brighton, 1.

ABSTRACTOR of scientific and technical literature at the Shirley Institute, Didsbury, Manchester—The Director of Research.

Official Publications Received

Great Britain and Ireland

P E P (Political and Economic Planning). Report on the British Social Services: a Survey of the existing Public Social Services in Great Britain with Proposals for Future Development. Pp. 206 (London: P E P.) Paper boards, 7*s.* 6*d.*; cloth, 10*s.* 6*d.* [18

London School of Hygiene and Tropical Medicine. Report of a Meeting of the Ross Institute Industrial Advisory Committee held in the Council Chamber of the Rubber Growers' Association on Friday, 28th May 1937. Pp. 24. (London: London School of Hygiene and Tropical Medicine). [30

The Story of the General Register Office and its Origins from 153 to 1937. Compiled by the Registrar General and illustrated by certain Exhibits shown at the General Register Office, Somerset House, Strand, W.C.2, in commemoration of the Centenary 1837–1937 of the General Register Office and Registration Service in England and Wales. Pp. 30+6 plates. (London: H.M. Stationery Office.) 6*d.* net. [30

Transactions of the Royal Society of Edinburgh. Vol. 59, Part No. 5: The Early Stages in the Development of the Ferret; the Formation of the Mesoblast and Notochord. By Dr. William Hamilton. Pp. 165–193+7 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 6*s.* 3*d.* [30

Committee on Bird Sanctuaries in Royal Parks (England). Report for 1936. Pp. 35. (London: H.M. Stationery Office.) 9*d.* net.

Scottish Education Department. Report on the Royal Scottish Museum, Edinburgh, for the Year 1936. Pp. 19. (Edinburgh and London: H.M. Stationery Office.) 3*d.* net.

Other Countries

Imperial College of Tropical Agriculture. The Principal's Report for the Year 1935–36 and the Accounts for the Year ended August 31, 1936. Pp. 36. (Trinidad and London: Imperial College of Tropical Agriculture.) [2

Rapports sur la photoluminescence présentés à la Réunion Internationale de Photoluminescence, Varsovie, 20–25 Mai 1936. Publiés par la Société Polonaise de Physique sous la rédaction de Prof. I. S. Pieńkowski et Dr. W. Kapuscinski. (Vol. 5 des Acta Physica Polonica). Pp. ix+431. (Wilno: Acta Physica Polonica.) [2

Report of the Committee on the Measurement of Geologic Time presented at the Annual Meeting of the Division of Geology and Geography, National Research Council, May 1, 1937. Pp. ii+ (Washington, D.C.: National Research Council.) [3

Ringkøbing Fjords Naturhistorie i Brakvands-perioden 1915–19 Udgivet af A. C. Johansen och H. Blegvad, under redaktion af Spärck. (Udgivet paa Carlsbergfondets Bekostning.) Pp. vi+2 (København: Andr. Fred. Høst and Søn.)

National Geological Survey of China. Palæontologia Sinica, Se C, Vol. 7, Fascicle 5: On the Mammalian Remains from Localit at Choukoutien. By W. C. Pei. Pp. 120+6 plates. (Peiping: French Bookstore.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 151: Experimental Research on the Effectiven of Ailerons and Elevators. By Taitiro Ogawa and Kadu Itô. 349–420. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 1.00 yen.