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## Conservation of Buildings and Landscape

THE discussion which took place in the House of Commons on February 10 on the motion of Mr. A. C. Bossom, member for Maidstone, on the destruction of beauty in town and country and of buildings of historical or architectural interest now proceeding in Britain, evoked a striking unanimity in expression of opinion from all sides. The motion had not only called upon the House to deplore the present situation and to agree as to its urgency; but it had also pressed upon the Government the need for active steps to ascertain "whether its existing powers are adequate, or whether they require substantial reinforcement". No voice was raised to repudiate responsibility, or to deny that this destruction was in the least degree anything but a serious matter of public concern; while in the final result the motion was adopted by the Government, and an inquiry promised.

In the course of the debate, it became evident that there was a general consensus of opinion that control of development, in so far as it affects the beauty of rural Britain, the preservation of structures of historic interest in a broad sense, and the protection of buildings and landscape from grossly incongruous structural associations, is in present conditions a national duty and not merely a matter of a local sense of responsibility. This also was the view, it may be mentioned incidentally, strongly urged by Sir Halford Mackinder and Sir Percy Hurd before the Council for the Preservation of Rural England on the following day.

While the House of Commons paid well-deserved tribute to the success of the Office of Works in carrying out its duties in the protection of ancient and historic monuments with the exiguous resources at its disposal, it was pointed out in debate

that in the most extensive field of its operations, that of the inhabited house, its powers are restricted, and that here even more than elsewhere, its activities are impaired by lack of funds.

The inhabited house has always presented a difficult problem in this connexion. To a certain extent, no doubt, shortcomings in the action now open to public authority will be met by the legislation to be introduced on behalf of the National Trust, to which reference was made in the reply for the Government by Mr. R. S. Hudson, Parliamentary Secretary of the Ministry of Health, accompanied by an assurance of the good will and sympathy of the Ministry of Health, the Office of Works and the Treasury. The scheme, however, for which powers will be sought, as it is understood, will apply in the main to the larger and more important examples of domestic architecture, and will be of little avail for structures of lesser pretensions and the villages typical of rural Britain in its varied cultural phases, for which Mr. Marshall, member for Sheffield, stressed the importance of preservation, as a unitary whole, as examples of "an architecture wedded to the landscape in which it is situated", each of a type and characteristics peculiar to its environment.

The problem of preserving these humbler structures should not be insuperable. Recent experience in reconditioning has shown how far villages, in which buildings have already been or are about to be condemned, may be preserved at a reasonable charge, and that whole villages need not necessarily be radically changed in character or ruthlessly spoiled on a demand for sanitary reform, which is blind to all considerations but one, important as that may be. The ways of the county surveyor and the rural district council,

however familiar, never cease to seem wonderful. Even in urban conditions where the call for improvement may be more insistent and financial considerations more difficult to meet, it may yet be possible to preserve historical and cultural associations, other things being equal, by the application of modern methods of reconditioning.

Of the two factors, lack of interest or knowledge and finance, which enter into the problem and appeared to weigh most with members of the House as insistently demanding the intervention of central authority, the latter, finance, demands by far the more drastic treatment. As Mr. Hudson pointed out in his reply, and as was mentioned by other speakers, training and knowledge are, or can be made, readily available for the advice of local authorities. Yet while it is true that there are numerous local societies—field clubs, natural history societies and archæological societies—distributed up and down the country, of which the members are fully competent, as the Parliamentary Secretary suggested, to educate their neighbours, anyone who is acquainted with actual conditions is well aware that the standing of these societies and the influence which they can bring to bear when action is contemplated in any given instance, varies enormously from one locality to another. The expression of instructed opinion available in these bodies needs to be co-ordinated and disseminated in such a manner that its weight will receive due recognition. For such an organized expression of opinion the machinery already exists in the various associations and federations in which these societies combine for the discussion of common interests. In certain directions and on occasion, common action is taken, at times with conspicuous success. More systematic organization with the specific needs of the present situation in view is required.

Further, would it be too much to ask, failing a systematic survey and enumeration of ancient and historic structures worthy of preservation, such as has been carried out by the Surrey County Council, and is, it is stated, to be urged on other authorities, that each town-planning scheme should include a clause safe-guarding such structures? Such a clause would show that an authoritative opinion had been obtained that no building of historic or æsthetic interest and importance had been marked for demolition, or, if any such there were, a reasoned justification for its destruction would be put forward for consideration and decision by central authority.

It is questionable if even this goes far enough. Excellent though the work of the Council for the Preservation of Rural England and similar organizations may be in creating a public sense of responsibility, no unofficial body, can view conditions so comprehensively, or speak with the authority of a central body or department, with powers delegated from the people as a whole.

Finance is obviously the real crux of the problem. Upon whom is the expense of conservation to fall? Even under existing legislation, the powers of a local authority are considerable, though, it may seem unfortunately, permissive only. The town-planning acts make it possible for the authority to intervene—but do not require that it must intervene—when the demolition of a structure of historic interest is contemplated. At once there arises the question of compensation, with all the possibilities of abuse. Nor is it practical to expect that an authority with only a low rateable value upon which to draw, will contemplate action entailing heavy expenditure, whether for purchase or compensation, with an entirely open mind. At the same time, to brand indiscriminately development of land or an urban site as merely personal greed, because such development conflicts with æsthetic ideals or archæological and historical interest, is to invite derision from those whose co-operation it is desirable to enlist.

Each instance must be judged on its own merits; and the arguments which weigh for conservation should help to determine where the financial burden should fall. When national considerations determine the issue—and this must cover the claims of associations bound up with the nation's history at large—or matters of wide general interest in the scientific pursuit of archæological and historical studies, as in the instances of the Roman Wall and the country around Stonehenge and Avebury, the burden of conservation is one which should fall on the nation's purse. A scale of grants might well be devised for the assistance of local funds, when interests more restricted in range, but nevertheless of historic, scientific or æsthetic weight, are involved and public action is demanded. On the broad issue, however, the principle should stand. As Sir Halford Mackinder said on the occasion to which reference has already been made, we and the countryside have grown together; the loss of its beauty would be the loss of half of ourselves; and its protection should be a national charge.

## The Fullness of Days

### My Fill of Days

By Sir Peter Chalmers Mitchell. Pp. 440. (London: Faber and Faber, Ltd., 1937.) 15s. net.

THE modern practice of using single words, or fragmentary sentences, bearing little or no relation to the subject-matter, as the titles, not only of novels—where it is excusable—but even of important biographical works, will undoubtedly cause much embarrassment, and even loss, to the historian and bibliographer of the future; but if ever such a title was justified, it is justified by the absorbingly interesting volume before us. It may be said at once that no man has ever lived, the fullness of whose days has been more striking and complete than those of Sir Peter Chalmers Mitchell, from the time that he made fireworks and other scientific experiments as a schoolboy, until he left the smoking ruins of Málaga, on a British destroyer on February 11, 1937. Chalmers Mitchell is a man devoid of fear—though perhaps, to quote Dr. Johnson, he never snuffed a candle with his fingers—but probably the boldest, one might say the most foolhardy event of his life, was his return to Málaga immediately after the publication of this volume, in which he gives a vivid account of Málaga in 1936 (chap. xx) and makes no concealment of his attachment to the so-called Red (Government) régime, and his activities in protecting and assisting the escape of 'Red' proscripts. What emerges most significantly from this book for 'the eye of wisdom' is a side of the author known only to his most intimate friends. He reveals himself here as a poet and as an artist, capable of warm-hearted and disinterested sympathies for the oppressed, and a loving and lovable nature—rarely to be found in those who, like him, are actively disinclined to the suffering of fools gladly—as recommended by St. Paul.

Chalmers Mitchell's descriptions of scenery, for example, of the Biscayan coast, of Montpellier, and of Arles, to quote but three vivid passages, are the unconscious work of both poet and artist, nor are his pen-pictures of the celebrated men who have been his friends and colleagues, to name but a few out of very many, Ramsay, Clemenceau, Ruskin, Freeman, Minchin, Ray Lankester and Burdon Sanderson, less striking and exact—as the present reviewer, having personally known most of the subjects of his pen-portraits, is in a position to appreciate. Equal in quality and charm is his description of Oxford and its influence upon the adolescent mind, a description that will awaken

echoes in the mind of every whilom undergraduate.

It is interesting to note the record that the author narrowly escaped being a son of Sir Archibald Geikie, in which case the world might have honoured a great geologist, instead of a zoologist of world-wide reputation. It is a task of extreme difficulty to pick out the salient features of a book, almost every paragraph of which arrests the attention of the reviewer, for the author writes as he talks—or lectures—in a style that is incisive and arresting, interspersed with sly flashes of humour which no Scotsman would resent being described as 'pawky'. The plan of his idealized Zoological Gardens may be said to have originated in the 'Zoo' at Hamburg, long before the days of Hagenbeck, who later became an intimate friend, adviser and colleague. At this period, he heard in Berlin the first indication of Bismarck's *Welt-politik* (in 1884), and in that connexion we get here a lucid statement and study of the inter-relations of Great Britain and Germany. He has saved from oblivion, in these pages, his article published in the *Saturday Review* (Feb. 9, 1896) entitled "A Biological View of Our Foreign Policy", in which the cataclysm of 1914–18 is soundly and clearly adumbrated.

Valuable advice is given to lecturers, founded upon the author's own vast experience, and no one who has delivered a Friday evening discourse at the Royal Institution will fail to appreciate sympathetically his mental reactions when undergoing that terrifying experience. His first enforced plunge into the science of accountancy (p. 100 ff.) sheds a significant light on the mastery of finance which he unexpectedly displayed when he became secretary of the Zoological Society.

The pages devoted to 'Weissmannism' are lucid and instructive; and it is amply apparent to what an extent his friendship with Hagenbeck encouraged him in the reform of the old Zoological Gardens, and in his views upon the treatment of animals in captivity, which led to the crowning episode of his life, the establishment of Whipsnade, the history of which must fascinate any zoologist.

The author is usefully polyglot, and he lays stress upon the influences of French literature, though doubtless many critics would meet him in the gate when he sandwiches Octave Mirbeau between Zola and Anatole France. His almost lifelong industry as a journalist has been amazing. He has been a prolific leader writer in the *Saturday*

*Review*, in *NATURE* and, above all, on the staff of *The Times*, all of which led to the important part that he played at the Ministry of Intelligence and Propaganda during the Great War, and especially to his attempted flight from Cairo to the Cape, which, from circumstances over which he had no control, may be described as a brilliant and useful failure. His description of this journey as a scientific spectator reads like an adventure story, and occupies some seventy pages of this remarkable book.

We have already referred to Chalmers Mitchell's vivid picture of Málaga in 1936, a description for which we were prepared by his long account of the conditions existing there, published in *The Times* (October 20, 1936). Where one must, we think, accuse him of hasty judgment is where he connotes brains and ill-health. He says (p. 209): "I cannot

recall . . . any person greatly distinguished by the product of his brain, who was a type of good health." We would answer this blazing generalization with the question: "What about Peter Chalmers Mitchell?"

The Epilogue will be read with close attention and with very varied reactions by a vast number of readers. The author is a convinced, almost a militant, Communist. It cannot fail to arouse the interest and the regretful appreciation of the most hardened Conservative. If only his gospel were in any degree credible the world would be profoundly modified—whether for better or for worse is a controversial matter. One may, we think, fairly say that the Epilogue is the dream of a Communist poet, crystallized—and beautifully crystallized—into a politico-utopian creed suitable for an Ideal Commonwealth.

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## Electron Theory of Metals

### The Theory of the Properties of Metals and Alloys

By Prof. N. F. Mott and Dr. H. Jones. (International Series of Monographs on Physics.) Pp. xiii + 326. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 25s. net.

THE great interest with which the electron theory of metals has been received by physicists is due chiefly to two reasons. The first is the practical importance of metals and their great variety, enhanced by the possibility of alloying different metals. Thus a large amount of experimental data has been collected, and offers an extensive field for theoretical investigation which, in its turn, will be helpful from the practical point of view as a guide for the classification and discussion of the material.

The second reason lies in the fact that, before quantum mechanics, metals represented one of the greatest puzzles of theoretical physics. At a time when the properties of atoms, the structure of ionic crystals, etc., were at least qualitatively understood, any attempt to explain the behaviour of electrons in metals landed one in hopeless contradictions. Therefore it was natural that when the papers of Fermi, Pauli and Sommerfeld showed that the difficulties could be overcome with the aid of quantum mechanics, the centre of interest in the theory of metals lay in these difficulties and their removal. One saw how Fermi's statistics reconciled the absence of a high specific heat of the conduction electrons with their large contributions to electric and thermal conductivity, and how the wave nature of the electron recon-

ciled the strong forces acting on the electrons with a mean free path greatly exceeding the atomic distance. There was a large number of similar questions, all concerning the properties of metals *as a class*. During that time the other aspect of the theory of metals, the discussion of the differences between *individual* metals and the relations between the properties of any one metal, was neglected.

This group of problems has been attacked only in the last few years in a number of papers, among which those of the Bristol workers are of outstanding importance. In the excellent account they give in a new volume of the "International Series of Monographs on Physics", Prof. N. F. Mott and Dr. H. Jones very rightly emphasize this second point of view, and indeed theirs is the first book on metal theory in which the properties of individual metals are reliably discussed and explained. At the same time they do not neglect the other aspect of the subject, and give a good introduction to the general foundations of the theory of metals.

The work which they discuss, and the many original contributions to the subject they have made in the course of preparing the book, are with few exceptions based on the picture of one electron moving in a field of force. In other words, the correlation between different electrons is neglected or at least greatly simplified. This limitation is customary in the theory of metals, and is imposed by the need of avoiding mathematical complications which nobody has yet been able to overcome and which are not likely to be

overcome in the near future. This 'one-electron approximation' results in a slight uncertainty in the predictions of the theory; it is most probably responsible for the failure of the theory to account for supraconductivity. The authors point out clearly where use has been made of this simplification, and which results may possibly be affected by it. One would thus not be surprised if the results agreed with the experimental evidence less well than they actually do; they seem to confirm a general rule—very comforting to the theoretical physicist—that "every approximation gives better results than it might do".

It is, of course, not possible here to give a complete list of the problems dealt with in the book, but they include a thorough discussion of the structure and the thermal, optical, magnetic and electric properties of metals. Surface phenomena, such as the thermionic emission and the photo-electric effect, are wisely omitted. Also electron diffraction is not mentioned—which is perhaps a pity, since it would have been instructive

in connexion with the 'zone structure' of the electronic levels inside a metal.

On all these problems, the theoretical situation is reviewed and the empirical constants are related to the fundamental constants of the metal in question, or, as in the case of the cohesion forces and the elastic constants and the specific heat at low temperatures, calculated on purely theoretical grounds. Then the experimental data are reviewed in the light of the theoretical results.

Every mathematical proof is preceded by a short qualitative argument showing its main points, and in this way the important steps remain clear to a reader who does not want to follow the formal argument in detail. This, together with frequent cross-references and a large number of diagrams and tables, makes the book also very handy for reference to special points.

It need scarcely be said that the exposition is as clear and the mathematical treatment as simple and reliable as we have become used to expect of a book that bears Prof. Mott's name. R. P.

## Reinforced Concrete

### (1) Principles of Plain and Reinforced Concrete Construction

By Dr. E. Probst. Pp. xii + 344. (London: Edward Arnold and Co., 1936.) 30s. net.

### (2) Elementary Structural Problems in Steel and Timber

By Prof. C. R. Young. Second edition. Pp. xiii + 315. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 20s. net.

### (3) Architectural Graphic Standards:

for Architects, Engineers, Decorators, Builders and Draftsmen. By Charles George Ramsey and Harold Reeve Sleeper. Second edition. Pp. xii + 284. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 30s. net.

(1) FOR a number of years, as professor and director of the Concrete Laboratory, Karlsruhe, as a private investigator in his own laboratory and as a practising engineer, Dr. E. Probst has studied the use of concrete, its properties and its possibilities, and the results and conclusions arising out of this work have recently been published. In the English translation, "Principles of Plain and Reinforced Concrete Construction", for which the author accepts responsibility and which may therefore be taken as authoritative, his investigations

have been described and explained in an easy style and in full accord with English nomenclature and units, the notation and symbols being those adopted in the Report of the Reinforced Concrete Structures Committee (Department of Scientific and Industrial Research).

Dr. Probst takes the view that, in general, the solutions of the unexplained problems of concrete construction are to be obtained from a study of the material itself, not as an idealized structural material constituted according to preconceived theories and more or less dissociated from the purpose for which it is required, but with the steady aim of bringing design, calculation and execution into harmony with the peculiar and individual properties which the material can be shown to possess. With this purpose, the author first examines the plain concrete, noting the properties of the various cements and aggregates used and discussing their testing, grading and mixing, and the physical and chemical properties of the mortars and concretes which they can be made to form. Relative to the influences of different qualities and proportions of the materials used, of shape, of methods of curing and other causes on the final result, extensive data have been collected and explained, and suggestions given as to those most suitable for particular conditions. Passing lightly over the subject of the qualities and forms of steel in use, the author treats at

length the combination of concrete and steel, citing the results of numerous tests and observations and, in addition, examining the effects of ageing, heat, electric currents and chemical action.

In the second part of the volume, the statics of reinforced concrete structures are discussed and elaborated in relation to cases of axial tension and compression and to those of bending, and the calculation of normal and shear stresses in reinforced concrete sections is explained. The internal stresses at various periods after placing and those due to repeated loading are closely examined, and are shown to differ appreciably from the previously assumed modes of distribution, thus suggesting the need for revised methods of calculation such as are here exhibited. By means of a number of examples it is shown how the equations deduced in this investigation can be applied in simple designs.

(2) Prof. Young's book, in its second edition, contains many new problems involving the design of entire structures or portions of structures in addition to all the original material which is not out-dated by present-day methods. It is, in the main, concerned with the design of steelwork in buildings, bridge spans and cranes and also gives a substantial section to timber beams, trestles and roofs. The new material introduced includes welded connexions, a floor panel using reinforced concrete joists, and several other typically modern examples.

(3) "Architectural Graphic Standards" is an encyclopædia, wholly in the form of drawings, of building construction, fittings and furnishings, and gives the usual sizes of practically every item of which an architect is likely to require data. Here also reinforced concrete is largely represented in the new matter introduced.

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## Zulu Society

### The Social System of the Zulus

By Eileen Jensen Krige. Pp. xix + 420 + 12 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd.; Johannesburg: University of the Witwatersrand, 1936.) 25s. net.

FOR several reasons the Zulus were for long, to the British public, the typical and, notwithstanding the eccentricities of Bushmen and Hottentot, the best-known of the indigenous peoples of South Africa. Their highly organized society and their resistance to British arms, especially at Rorke's Drift in 1879, made a deep impression on the popular imagination. The high estimate of Zulu character to which this gave rise found confirmation in the fiction of Rider Haggard. Further knowledge of the number of distinct peoples to be found in South Africa and of their marked differences has not entirely obliterated the impression.

Miss Krige's account of Zulu society, though not a comparative study, gives the English public a fuller and more comprehensive picture of its essential and distinctive features than has as yet been available within the compass of a single volume. For the anthropologist she has provided an invaluable summary of previous records, classified, digested and interpreted in the light of personal investigation among the people as they are to-day. Obscurities, omissions and doubtful points have been cleared up by inquiry from those among the people themselves who are reputed to be best acquainted with tradition.

As with other native peoples of South Africa, the place of origin of the Zulu is unknown, the attribution to West Africa, which has been favoured, resting on an early Portuguese inference of little value. Their traditions suggest that they were in South Africa in the sixteenth century. The crucial period of Zulu history, however, and their dominance among South African tribes, lies in the nineteenth century. In the early years of that century, Shaka acceded to power as king, and moulded his people into a fighting unit, organized into regiments, which maintained its independence until the fall of Cetewayo in the Zulu War of 1879.

Shaka was a man of strong and ruthless character, possessed of a genius for political organization, such indeed as is not without parallel in African history, but in his instance of an exceptional order. The consolidation of the Zulu people and the extension of their power was coupled with the rise of the Matabili and other movements of peoples, which affected tribal distributions so far north as Lake Nyasa. It was not unique. Similar consolidations appear to have taken place elsewhere in Africa at about the same time, or not long after. In the present state of African research, the predisposing conditions are not clear. Similarly, the regimental organization was based on the advantage taken of the age classes common to most Bantu peoples. In these and other details of Zulu organization, Shaka showed his outstanding ability by bending them

to serve his purpose of Zulu supremacy and his own personal dominance. Obviously Zulu history is not without its lessons for to-day, when it thus demonstrates the political capacities and social adaptability of the African along lines congenial to his traditions.

This and like reflections must occur to any reader interested in the African, who takes Miss Krige's book in hand. Such broader implications

of the theme lie beyond her scope; but she sketches the history of the Zulu people adequately to show its bearing on the development of Zulu society. Much of the old military organization, such as the regiments, survives, although it has lost its military purpose and meaning; and checks and counter-checks devised to consolidate Shaka's power, as for example in overriding the witch-finder, are still operative.

## The Nile

### The Nile:

*The Life-Story of a River; from the Source to Egypt.* By Emil Ludwig. Translated by Mary H. Lindsay. Pp. 352+34 plates. (London: George Allen and Unwin, Ltd., 1936.) 16s. net.

IN this book a famous biographer has attempted to give a description of the course of the Nile from its sources to the sea as if it were the life-history of a person. In it the reader with no first-hand knowledge will find much interesting information about the topography, vegetation, human and animal life, and history of the Nile basin, and may think that he is reading an authoritative work by one who has seriously studied the river and travelled extensively in its basin. If, however, he is sufficiently interested to pursue the subject further and refers to standard works, his confidence in the author will be badly shaken by the many mistakes which he will discover. The book is written in flowery language, and the reader will become very weary of the personality device and its meaningless symbolism before he comes to the end.

The first portion of the book is concerned with the great Lakes Victoria and Albert and the surrounding country in which the White Nile has its sources. Some of the information produced about the region is a little surprising, as for example the natural bridge at Nimule, "such as hardly another river on earth possesses in this form, consisting of rank water plants, so strong that it bears the elephant from one bank to the other, and so powerfully rooted that when floods have destroyed it, it closes up again of itself". Nobody else has ever reported this bridge, and as an elephant weighs five tons or more, the rank water plants must have been considerable trees. Some of the remarks about evaporation are equally strange, for the author says: "As Lake Victoria is not three hundred feet deep, so that more water evaporates than is received, this constant diminution, as we shall see later, presents the Nile engineers with a very grave problem." This is

an example of the lack of knowledge of the elements of natural science displayed in the book and of the inaccuracies which are of frequent occurrence. Lake Victoria has not progressively diminished in volume in the forty years over which records extend, though, like other large lakes, it has fluctuated with the variations of the rainfall.

The author continues his description of the White Nile and then describes the Blue Nile and the Atbara, with some account of the history of Abyssinia, and the Main Nile as far as Aswan, the description of Egypt being left for a second volume. Towards the end of the book he has a few paragraphs on hydrology in which he gives some figures about the volumes of water flowing in the various tributaries. As many of these figures are badly wrong, it would have been better to have omitted them.

The remarkable feature about the book is the number of errors it contains. Some, like the picture of hippopotami entitled "rhinoceros" and the statements that the hippopotamus has been seen starving to death on phantom islands of grass, and that the Atbara rises in Lake Tana, will be readily detected; others, like the statistical errors, of which there are so many, will escape the notice of the general reader and be assimilated and perpetuated, for a false statement once started can never be overtaken. The most reliable feature of the book is the maps, which are taken from another work.

It is a misfortune that a book which is written by a well-known author should be so unreliable; but in a serious description of natural phenomena there is no excuse for gross inaccuracies, and the author owes it to his own reputation as well as to his readers to make no mistakes in his presentation of facts. Perhaps the lesson may be drawn that literary ability will not make up for lack of knowledge of the subject, and we recommend this consideration to the author before he produces the second volume of the work.

H. E. HURST.

**Differential and Integral Calculus**

By Prof. R. Courant. Translated by Prof. J. E. McShane. Vol. 2. Pp. x+682. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1936.) 30s. net.

THE English edition of Vol. 1 of this work was briefly reviewed in NATURE of March 9, 1935, and the present volume is a translation, also by Prof. McShane, of the original German text which was published in Berlin in 1929. It is devoted to the more advanced parts of the calculus; chiefly to functions of several variables and their physical significance. As in the case of vol. 1, this edition differs in several respects from the German. It is indeed a much larger book, for there were only 360 pages in the original. Considerable additions have therefore been made, consisting mainly of an extended chapter on differential equations; new chapters on the calculus of variations and on the complex variable, whilst a supplement on real numbers and the concept of limit has been provided at the end. It may be remarked that it seems somewhat strange that the text of a modern book on advanced calculus should have to be amplified by a treatment of the complex variable.

The course, introduced by a chapter on the fundamentals of analytical geometry and vector analysis, embraces the usual topics generally considered as advanced calculus—derivatives of functions of several variables; multiple, line and surface integrals with the theorems of Gauss, Green and Stokes; differential equations with special reference to mechanical and physical problems, etc. Chapters ii-v are each followed by a useful appendix in which the relevant theory is further elaborated.

The needs of the student are well provided for, as the book not only abounds in copious exercises, but also devotes fifty-five pages at the end to answers and helpful hints. Mention should likewise be made of the very full and valuable summary of important theorems and formulæ. The text is well developed, clearly illustrated and excellently printed.

F. G. W. B.

**The Birds of Tropical West Africa:**

with Special Reference to those of the Gambia, Sierra Leone, the Gold Coast and Nigeria. By D. A. Bannerman. (Published under the authority of the Secretary of State for the Colonies.) Vol. 4. Pp. xl+459+14 plates. (London: Crown Agents for the Colonies, 1936.) 22s. 6d.

THE publication of Mr. Bannerman's six-volume work on West African birds has been suspended midway for nearly three years, owing to financial exigencies of the times which have affected the Colonial Governments supporting it. Happily, these difficulties have now been surmounted, and with the appearance of this volume there is prospect of the early completion of a valuable record which should place the ornithological study of the region in a strong position. The book, it may be repeated, admirably serves the double purpose of a summary of existing knowledge and an aid to further investigation. In the latter respect, great pains have been taken to assist the

observer in identification. As well as the detailed description of each form, there is at the beginning of the volume an illustrated key to the families and genera, and there is also for each family a further key to the genera and species. This useful feature was included in the earlier volumes, but it is especially welcome now that Mr. Bannerman is dealing with the huge and difficult order Passeres, the treatment of which will occupy the whole of the second half of his great work. In addition to text figures, the fourteen coloured plates beautifully depict sixty-five different species.

**The Modern Dowser:**

a Guide to the use of the Divining Rod and Pendulum. By Le Vicomte Henry de France. Translated by A. H. Bell. Pp. xvii+139. (London: G. Bell and Sons, Ltd., 1936.) 4s. 6d. net.

THE subject of dowsing is one to which a great deal of attention has been given in France in recent years, and its range of application has been extended in many directions, chiefly in the field of biology and medicine. This little book gives an excellent summary of the main facts, but its chief value lies in the instructions given which enable the reader to experiment for himself. Contrary to the practice of most of the best English dowsers, the author makes great use of the pendulum, and most of the instructions refer to this rather than the rod. As is usual in books on this subject, the physical explanation given could not be accepted by physicists in the form in which it is given, and when the author's account of the claims with regard to distinguishing wines, finding aeroplanes, and diagnosing disease are examined, the scientific imagination is stretched to the limit. However, there is no doubt of the enthusiasm with which the study of this curious, and in some sense genuine, human faculty is being carried on in France, and it is to be hoped that further experiment will throw some light on its physical nature.

**Inorganic Preparations:**

a Systematic Course of Experiments. By Alexander King. Pp. xi+164. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1936.) 5s. 6d. net.

THE present book contains detailed descriptions of 187 preparations, and sketches of almost as many additional preparations. The accounts of the experiments are sufficiently detailed to ensure success, and references to the literature are given. The text is arranged under the headings: physical state, elements, binary compounds, acids, bases and salts, complex salts, compounds of some rarer elements, and reactions which form the basis of some industrial processes. Many of the experiments are suitable for pupils in schools and the more difficult ones for university courses. They will form a valuable supplement to the courses in analysis, which fail to teach many important aspects of laboratory manipulation. The book may be warmly recommended, and it deserves to be widely used.



## The Percy Sladen Expedition to Lake Titicaca, South America

By Prof. J. Stanley Gardiner, F.R.S.

AT the International Geographical Congress held at Cambridge in 1928, Mr. Hope-Jones and Major Vallenas, representing the Sociedad Geografica de Lima, suggested that a British

and the Trustees of the British Museum. The expedition is also receiving a generous welcome from the Peruvian and Bolivian Governments.

Lake Titicaca is situated in an area in the middle



Fig. 1.  
Lake Titicaca.

expedition be arranged for the investigation of Lake Titicaca in all its aspects, and proffered the support of their Society. Owing to financial conditions in Great Britain, the contemplation of such an expedition was not possible then or for some years. Finally, in January 1936, the matter was referred to the Percy Sladen Trustees, who decided to send an expedition to work on the lake during the winter or dry season (April–October) of the present year, the proposed researches meeting with the complete approval of the Royal Society

of the Andes, where these mountains branch and afterwards rejoin, and about two thirds of the lake are in Peru and a third in Bolivia. It is situated at 12,500 ft. above sea-level and covers more than 3,000 square miles, its deepest sounding at present being 273 metres. It is fed mainly by streams from the mountains, which attain a height of 22,000 ft. to the east, while the railway pass from Molliendo to the west is at 14,666 ft., the total area of this central plain being more than 100,000 square miles. The lake itself is subject to differences in

level of its waters, the causes of which are not clear, since it has an outflow by the Rio Desaguadero to the shallow Lake Poopo, about 300 miles to the south. Around this is a large area of partially overgrown marsh, into which there is extensive seepage from Poopo, the whole plain having no communication on any side with the sea. On Lake Titicaca the nights are cool, often with ground frost, but the days frequently experience a temperature range of 60°–70° F. However, the temperature of the lake remains relatively constant, perhaps due to the strong winds along its length from south to north causing mixation of its waters.

The country around, almost certainly the original home from which potatoes were imported into Europe, is for the most part dry and bare of timber. It is approached by the Southern Railway of Peru, the main line of which extends north to the Cuzco region, the central part of the Inca Empire. Around it are lead and other mines, and the Peruvian Corporation, which has most generously extended its help to the Expedition, besides managing the railway and conducting business enterprises, runs a regular steamer service from Puno in Peru, a town of more than 20,000 inhabitants, to Huaqui in Bolivia. Around the lake are a few small settlements, and the Island of the Sun in the Bolivian area is the centre of an important pilgrimage.

The lake itself is evidently little affected by drainage from settlements, and agriculture in its surrounding lands is little developed. It indeed seems to be fed mainly by glacier streams of relatively constant volume and composition. It was visited by Alexander Agassiz sixty years ago, when a few amphibians, two genera of fish and some higher crustaceans were obtained. Its birds were collected by an expedition from the American Museum, and lately there has been an investigation of its biology with the view of introducing more profitable fish, as has been done into some northern Peruvian lakes. Apart from the fauna and flora, the full range of which will have to be ascertained, the lake presents a unique field for ecological study. Its position suggests that it is a relatively primitive lake, and it may well belong to an 'oligotrophic' type, in contrast to the 'eutrophic' lakes of the East Indies and Central Africa. In this connexion, the question of its nitrogen cycle will be a main object of interest, the distribution of nitrates, nitrites, ammonia and organic nitrogen, the seasonal changes in the same at various depths to determine their transformations; such researches, perhaps owing to a certain simplicity in the lake, should form invaluable data for comparison with the more complicated phenomena of the sea. Simultaneous determinations will have

to be made of the quantity, composition and distribution of the plankton, which is as yet unknown. To obtain an understanding here will necessitate pH, oxygen, phosphate and other analyses. Further, the fauna and flora of the shallow waters of its long coast-line will have to be surveyed adequately and ecologically.

On the physical side, here is a lake with the sea-level pressure reduced to two thirds with consequent effects on wind-force. The solar radiation is greatly increased, especially at the ultra-violet end of the spectrum, which has particular biological significance. Here are two matters of which relatively little is known, and on which it is hoped that results may be obtained that will elucidate conditions in low-lying lakes. Measurements of light penetration are desirable to determine the limits in depth to which the phytoplankton can flourish. These are special subjects in the general hydrographical study of the lake and of its circulation as revealed by temperature and density observations.

The expedition as now arranged is under the leadership of H. C. Gilson, fellow of Trinity College, Cambridge, who will be accompanied by T. G. Tutin as botanist, H. P. Moon, G. I. Crawford of the British Museum, P. F. Holmes and D. M. Hall. All are graduates of the University of Cambridge, relatively young, because at these altitudes no others can, without long acclimatization, be expected to carry on the constant labour that the expedition will entail, and because to the optimism of such must be assigned the scientific attack in new directions, for which they have now been preparing for many months. They are to be joined by Dr. H. E. Hinton as a volunteer, his study being the water-living insects of the lake and streams.

The expedition leaves England on March 11, Messrs. Gilson and Hinton having proceeded in advance on February 18 to present their credentials to the Peruvian Government and to arrange for camp and commissariat on the lake, on which it is hoped to obtain six months' continuous observation. Besides the necessary scientific equipment, the expedition is taking out a motor-launch especially equipped for its daily observations, its speed of 16 knots at sea-level reduced to about 10 knots at this altitude. While the whole of the members of the expedition in respect to its objects are to a large degree interchangeable, it is anticipated that they will fall into pairs concerned with the chemical, physical and shallow water ecological observations, the plankton, fauna and flora being the concern of all. Clearly, this expedition will not be a 'joy-ride', and it is one to which the good wishes of all the scientific world will be gladly extended.

## The Measurement of Time

By Prof. H. Dingle

TIME cannot be measured as any other physical magnitude is measured. Measurement is the determination of the number of 'units' contained in the assigned quantity, and the unit is defined either (as with mass and space) as an arbitrarily chosen, permanently preserved piece of the magnitude in question, or (as with temperature, electric charge, etc.) as that which produces a specified amount of an arbitrarily chosen effect ultimately measurable in terms of mass or space. But it is impossible to preserve a standard second, and time produces no effects—events occur *in* it but not *because* of it. Consequently measurement of time must be a special process.

The only practicable procedure so far conceived is the following. Choose a sequence of events (natural or artificial) between consecutive members of which there is an interval of some other (measurable) physical magnitude as well as an interval of time; then the time intervals can be defined as proportional to the corresponding intervals of that magnitude. This process involves three successive steps:

(1) Choice of the kind of measurable interval between the events.

(2) Choice of the particular sequence of events separated by intervals of this kind.

(3) Choice of the unit of measurement of those intervals.

Physics has chosen under (1) intervals of space; under (2) the successive spatial positions of an ideal body free from external forces—represented approximately by the successive directions of a specified radius of the earth; and under (3) an ideal rigid rod, represented approximately by the standard metre.

Each of these choices is in the last resort arbitrary; there is nothing in Nature to prohibit the selection, for example, under (1) of intervals of mass, under (2) of the successive masses of any particular body, and under (3) of any standard unit of mass. There are differences in convenience, of course: no sane physicist would normally define equal times as those in which a Californian redwood tree acquired equal increments of mass according to a standard piece of uranium. But so far as Nature is concerned, this and the traditional measure adopted by physics are equally valid.

Before the theory of relativity was formulated, it was thought that each of the three steps was prescribed by Nature. Time must be measured in

terms of a sequence of spatial intervals; there was one unique uniformity of velocity defining the only valid sequence of spatial positions; and there was one unique standard for measuring the spatial intervals between those positions. Then came the discoveries that two rods, equal in length when relatively at rest, became unequal when in relative motion, and that in the latter circumstances it could not be determined which was moving. It followed that Nature's standard measuring rod in (3) could not be identified. Relativity saved the situation by pointing out that it was mythical, all standards being equally legitimate if used consistently. This discovery of the arbitrary character of step (3) is known as *special relativity*.

Steps (1) and (2) remained unique. This meant, first, that the unit of time must share the voluntary character of the unit of space, for since, under (1), time intervals were proportional to space intervals, any arbitrariness in the latter must appear also in the former; and secondly, that whatever choice was made under (3), the changes in space and time measurements could never convert uniform into accelerated motion, or vice versa, because, to preserve the uniqueness of (2), the units must be related so that the earth rotated uniformly. The supposed absoluteness of step (1) accounts for the common statement that time has become space. Having decided to measure time in terms of space measurement, it naturally follows that time and space measurements are related, but the relation does not belong to Nature. If intervals of mass or temperature had been chosen in (1), time would have 'become' mass or temperature. Again, the supposed uniqueness of step (2) accounts for the restriction of special relativity to uniform velocities: the equations of transformation had been determined experimentally for such velocities and the passage to accelerations was closed.

The next advance was the realization of the essential arbitrariness of step (2). Nature makes no demand that the earth shall rotate uniformly; we can choose *any* sequence of spatial positions, measure the space intervals between them by *any* standard rod, and define equal times accordingly. This discovery was *general relativity*; it destroyed the supposed absolute distinction between uniform and accelerated motion.

The effect on formal physical theory was in each case a simplification: special relativity

eliminated time, and general relativity mass (or force), as independent conceptions. A velocity was no longer definable only as so many space units divided by so many time units. A velocity of 4 miles an hour was a movement through 4 miles while the earth rotated through  $15^\circ$ , and could be expressed as "4 miles per  $15^\circ$ ". Space (or space-time, as it was called) measurement was thus adequate to describe velocity. A further elaboration of space measurement included force or mass, so the whole of metrical mechanics became expressible in terms of a single concept of space.

The arbitrariness of step (1) is not yet generally realized, but clearly we are just as free to choose a sequence of, say, entropy intervals as one of space intervals to define a time scale, and as a result we might expect an expression of the laws of thermodynamics in terms of a timeless entropy just as the laws of mechanics are expressed in terms of a timeless space. Two opposite extreme attitudes of physicists to this matter require attention.

In the first place, though apparently no one has explicitly noted the arbitrariness of (1), it is inherent in Milne's recent kinematical theory. Milne points out that any sequence of events whatever is valid for enumerating time instants, and this clearly gives us permission to choose events separated by intervals of any kind to provide a measure system for time. But he goes no further: having claimed freedom he takes no advantage of it, so that his claim, though perfectly just, is also perfectly useless. Instead of proceeding to advance physics by measuring some physical interval between the events chosen and defining a time scale in terms thereof, he restricts his consideration to the numbers identifying the instants themselves. The result is naturally that nothing of physical interest emerges; it is impossible even to distinguish between relative rest and relative motion until some choice of clock is made. Milne tries to define a basis of choice by postulating a 'cosmological principle', but this, being obviously beyond experimental confirmation, is metaphysical, and furthermore has not succeeded in making the distinction mentioned. Time is essentially immeasurable by ordinary processes, and you get out of its so-called measurement just what you put in. If you measure time in terms of space, time becomes space; if you measure it in terms of temperature, time becomes temperature; and if you measure it in terms of a cosmological principle, time becomes metaphysics.

At the other extreme is the position taken by the majority of physicists who, ignoring the voluntary character of (1), by implication accept as a natural necessity the measurement of time in terms of space. Probably the most emphatic

expression of this acceptance is Eddington's statement ("The Nature of the Physical World", p. 74) that the second law of thermodynamics holds "the supreme position among the laws of nature". His reason is that this law alone reveals "time's arrow". But clearly this distinction is arbitrary. Having elected in (1) to measure time spatially, we can choose, and have chosen, in (2) for defining equal time intervals the particular sequence of spatial events that puts an arrowless time in mechanical laws. Thermal laws, being temporally 'out of step' with mechanical laws, then show time's arrow. But if we choose in (1) to measure time thermally, and in (2) the sequence of thermal events which puts an arrowless time in the laws of heat (for example, we might define as equal times those in which a standard body radiates equal amounts of heat or falls through equal ranges of temperature or changes by equal increments of entropy, etc.—heat, temperature and entropy measurement, of course, being defined by an arbitrary choice under (3)), time's arrow goes over into mechanics, which then assumes the 'supremacy' now assigned to thermodynamics.

We must distinguish two things:

- (a) The *order* of events in time.
- (b) The *intervals between* events in time.

The first is independent of measurement and is not arbitrary. The second, which alone give us our mathematical 'laws of Nature', depend on measurement which is arbitrary in the three-fold manner indicated above. For example, the statement that entropy tends to increase belongs to (a); the statement that the increase tends towards a finite maximum value depends on (b). If we define equal times as those during which a standard body acquires equal increments of entropy, there is no finite maximum value, and the entropy of that body increases uniformly through eternity.

The system of measurement to be chosen depends on the question of interest. If we ask whether terrestrial life will ever cease through failure of solar heat supply, the appropriate system must be indicated by the biologist; if rhythmic vital processes adapt themselves to solar heat supply such cessation will never occur, but if they adapt themselves to our physical system of (approximately) uniform rotation of the earth, it probably will. The former would seem more likely to be the fact. There is, however, the further consideration that life may depend on terrestrial (determined by solar) temperature more than on heat supply (though the present maintenance of the same body temperature in the arctic and tropic zones prohibits dogmatism on this point), and the fact that the sun cools comes under (a) and not (b). That is true, but there is no evidence that it is a 'fact'.

Apart from arbitrary choice, there seems to be complete equivalence between mechanical and thermal processes. Both show a one-way tendency in (a)—moving bodies tend to stop and hot bodies tend to cool. We do not need a special entropy clock to show which of two instants is the later; a grandfather clock will do—the later instant corresponds to the lower position of the weight. In favourable circumstances (for example, the rotation of the earth), 'uniform' motion may be eternal, and in favourable circumstances (for example, the radiation of the sun) 'uniform' radiation may be eternal. There is no evidence that the sun's temperature is falling, apart from the laws of mechanics, which presuppose fall and are therefore inapplicable: on the contrary, there is much difficulty in accounting for the fact that the sun radiates *without* observable fall of temperature. We are no more compelled to say that an isolated body would move uniformly than that it would radiate uniformly: in each case we can observe only bodies that are not isolated, and we

find, first, that neither motion nor radiation is uniform, and secondly, that the nearer we approach isolation the nearer we approach a *common* uniformity of both motion and radiation.

Space prevents discussion of the possibility of re-expressing thermodynamics in terms of a thermal time measure, but there seems to be a reasonable prospect that choice of the proper thermal quantity for the purpose, and application of relativity methods of relating time with this quantity, would introduce the quantum of action,  $h$ , in a manner analogous to the introduction of the velocity of light,  $c$ , into spatial relativity. The relation of one constant to thermal processes at least partly resembles that of the other to mechanical processes. If this possibility were realized, the way would be open for a completely unified field theory. This, of course, is at present a speculation, but the three-fold arbitrariness of time measurement and the deductions drawn therefrom rest on logic and historical fact.

## Obituary Notices

Prof. Max C. W. Weber, For. Mem. R.S.

DR. MAX WEBER, for many years professor of zoology in Amsterdam, doyen of late of the whole brotherhood of zoologists, died at Eerbeek on February 7, in his eighty-fifth year. He was born at Bonn on December 6, 1852, of a Dutch mother and a German father, and learned his natural history from Franz Leydig in Bonn and from Eduard von Martens in Berlin. Leydig was an excellent anatomist, who gave Weber his lifelong bent towards mammalian anatomy; von Martens, a famous conchologist, who had travelled and collected in the East, was a man of fine taste and liberal education. In 1879, Weber went to Holland, where he taught anatomy, first in Amsterdam then in Utrecht, and presently went back to Amsterdam as professor of zoology. In 1883 he took out papers of naturalization, and married Mlle. Anna van Bosse, a young botanist of his own age, who proved herself the perfect wife and helpmeet.

Weber had already made a voyage to Barents Sea, in a little schooner 75 ft. long, the *Willem Barents*, named after Willem Barents who had discovered Spitsbergen at the end of the sixteenth century and so opened the way to that rich whale-fishery in which the Dutch had a paramount share for the next hundred years. The *Challenger* had not long come home, and Weber, like many another young naturalist, was all agog to go fishing in unexplored seas with dredge and trawl. For a few years after their marriage the Webers

went every summer to Tromsö, he mostly to dissect whales, and she to study corallines or calcareous algae, on which she was even then becoming the chief authority. In 1888 they went to the Dutch East Indies, where they made large and varied collections and where Max Weber took up in earnest the study of geographical distribution. He belonged to an age, and he was of late its most conspicuous survivor, when a man could take all natural history for his province, and could make discoveries in many diverse fields. In the *Ergebnisse* of this Dutch East Indian Expedition, in which many colleagues including his old master von Martens came to help him, Max Weber himself wrote on the freshwater sponges, on that queer trematode worm *Temnocephalus*, which is a parasite (and yet scarcely a parasite) on a river-crab, on the anatomy of certain Siluroid fishes, on local species of reptiles and of mammals, on the scaly coat of the pangolin and its associated hairs—which led him to think that all mammals were once scaly, and that in many the arrangement of the hairs recalled the ancestral pattern of the scales—and lastly, together with his wife, on the green and yellow algae symbiotic (to use a word lately coined by De Bary) in *Spongilla*.

The Webers' next journey was to South Africa—it was always to some homeland of the Dutch—again to study the freshwater fauna, and in Max Weber's case to study the anatomy of *Chrysochloris* and certain other South African mammals: the results

of this expedition were published in the *Zoologische Jahrbücher*. Then, in 1899, Weber, resigning his professorship and becoming professor extraordinarius, embarked (of course with his wife) on their famous Siboga expedition to the Dutch East Indies. The *Siboga* was twice as big as the *Willem Barents*, but was still a very little ship; she was of some 800 tons burthen, and carried a crew of fifteen all told. But the scientific work she did and the collections she brought home were out of all proportion to her size and the modest cost of the expedition. The splendid series of Siboga reports have been coming out under Max Weber's editorship for all these years, and are scarcely finished yet: they carry on the work that Rumphius had begun two hundred years before and that had been in abeyance ever since; and they give the *Siboga* an honourable place among the reports of the great historic voyages of exploration.

The Dutch East Indies are classic ground for the study of geographical distribution, and Max Weber had it from the first in mind to re-study Wallace's line, or whatever better boundary there might turn out to be between the Indian and the Australian regions. He was soon out of conceit with Wallace's line, which runs in the channel, not a deep one, between Bali and Lombok—"diese unglückliche Linie von Wallace", as he called it; rather does the Indian fauna begin to be impoverished in Bali, and to dwindle out in Lombok and Timor. Celebes is the great puzzle, not only as to the boundary-question but also for other questions of its own. It is an old story, but a truly amazing one, that the rich freshwater fish fauna of Sumatra, Borneo and Java, each of them with a hundred and fifty species less or more, practically disappears in Flores and Timor and Celebes: there is nothing left but one or two immigrants from the sea like *Symbranchus*, and one or two widespread fishes, tenacious of life, like *Anabas* and *Ophiocephalus*. Great families, Silurids, Cyprinids, Mastacembalids, simply disappear as we pass from Borneo to Celebes. As to what is often called the mixed fauna of Celebes, Max Weber was, I think, the first to lay stress on the great difference between the north and south halves of the island. Each half has its own population of squirrels; *Babirusa* and *Paradoxurus* and certain monkeys are confined to the north; and of sixty-four species of land-snails, only two are common to the two halves of the island. It was Max Weber who pointed out that, while Celebes occupies a deep-water area and Borneo, Java and Sumatra a shallow-water or continental one, the deep water around Celebes has a temperature of above 3°, instead of the usual 1° of oceanic bottom-temperature; there must therefore be some unknown barrier to separate the deep waters of the archipelago from the main ocean.

Conspicuous among the many Siboga reports are Max Weber's own on the fishes, marine and freshwater, and his wife's on the coralline algæ, or so-called nullipores. Mme. Weber van Bosse found these latter in vast abundance, though of few species; Stanley Gardiner had already shown their important share in the building of coral-reefs, and geologists

knew their vast importance as rock-builders, even (or so we are now told) in pre-Cambrian antiquity! As to the fishes, Bleeker, who had studied them for twenty years, had made known many hundreds of species from the rich tropical East Indian fauna; but among a thousand species in all, Max Weber found a hundred and thirty-one that were new to science, and two hundred and forty more that were new to the area in question. In Bleeker's time the deep-sea fishes were all unknown, there and elsewhere, for the *Challenger* and the *Valdivia* had not begun to discover them. Max Weber dedicated his great work on the Siboga fishes to his wife—"die mir im hohen Norden, in Süd-Afrika, im indo-australischen Archipelago, und auch während der Siboga Expedition eine immer freudige und hilfreiche Reisegefährtin war". In his later years, with the help of his pupil and successor Prof. L. de Beaufort, Max Weber undertook the task of setting in order the whole Indo-Australian fish-fauna, of some three thousand species in all. Of this great and laborious work seven volumes have appeared, and the old scholar was busy with the proof-sheets until within a few weeks of the end.

In the midst of all these great undertakings Max Weber had found time to write what is in some ways the greatest of them all, his text-book of the Mammalia. We have seen how comparative anatomy was his first love; he worked for years in Amsterdam in an old and rich museum, and next door to a fine zoological garden, which gave him continual work to do. His book "Die Säugetiere", did for mammalian anatomy what Owen had done when Weber was a boy; it was first published in 1904, and a much enlarged edition appeared in 1927-28, to which Otto Abel contributed the palæontological part and Prof. de Berlet (now of Groningen) certain anatomical chapters. From the days when he first learned his anatomy from Leydig, Max Weber never ceased to work at that inexhaustible and delightful theme; and among all his other abundant work, "Die Säugetiere" stands out a monument to his industry and his learning.

Max Weber was a childless man, but he had all else that should accompany old age. He was rich in honours. He had the order of Orange Nassau, the knightly order of the Lion of the Netherlands, and several foreign decorations. He was a foreign member of many academies, including our own Royal Society.

Weber was a great figure of a man. He had both charm and dignity, and he enjoyed for many years such general admiration and esteem as are only given to the very best of men. Fifteen years ago, when he reached his seventieth birthday, a letter was sent him by a number of English zoologists. They spoke with unaccustomed warmth, saying in conclusion: "Your solid learning has upheld the great scientific traditions of your country, your investigations have influenced and stimulated many of us, your broad interests, your singleness of purpose, the simplicity of your life and your genius for friendship have set an example for us all" (NATURE, 110, 780, Dec. 9, 1922).

D'ARCY W. THOMPSON.

## Dr. R. F. Rand

RICHARD FRANK RAND, a brilliant young surgeon trained at Edinburgh, was one of the Rhodesian pioneers and served as medical officer with the pioneer column sent by Cecil Rhodes to Mashonaland in 1890. As medical officer to the Chartered Company's police, and later chief hospital surgeon at Fort Salisbury, he devoted himself specially to the treatment of malaria, the scourge of the early settlers and then not recognized as a mosquito-borne disease.

The active period of Dr. Rand's long life was spent in practice in South Africa, chiefly at Salisbury and other places in Southern Rhodesia, and his great experience of tropical diseases was an important asset to the British forces in the Boer War and later in the Great War. His last years were spent in England, and he died very suddenly at his home at Brightlingsea, Essex, in his eighty-first year on January 3.

Rand was a keen naturalist, his great hobby was live botany; he not only collected but also keenly studied his plants in the field in intervals snatched from his always exacting medical duties. His collections of specimens sent to the British Museum Herbarium were accompanied by notes of his observations on their relation to environment, life-history and especially on details of floral structure and dispersal. He was one of the earliest collectors in Southern Rhodesia, and his gifts to the Museum in the late 'nineties and the early years of the present century provided many novelties. Accounts of these and his valuable field-notes and observations were published in the *Journal of Botany*. A. B. RENDLE.

## Prof. David Ellis

PROF. DAVID ELLIS, professor of bacteriology in the Royal Technical College, Glasgow, died suddenly at his home in Bearsden on January 16, aged sixty-two years. He was educated at the University College of Wales, Aberystwyth, and after graduating in the University of London in 1896, taught for some time as a science master in secondary schools. Later he proceeded to the University of Marburg where he gained his Ph.D. degree in 1902, for researches in bacteriology. On returning to Great Britain he again took up science teaching, this time in Dollar Academy, and from there he went, as lecturer in bacteriology and botany, to the Glasgow and West of Scotland Technical College, the lineal descendant of the old Anderson College, now the Royal Technical College, Glasgow. Later he was appointed professor of bacteriology in the College and superintendent of its Schools of Pharmacy and of Bakery.

For his researches in mycology, Ellis obtained the D.Sc. of London in 1905. From 1907 until 1919 he was lecturer in nature study to the Glasgow Provincial Committee for the training of teachers, and during that period he was, for many years, chief examiner in botany to the Central Welsh Board. He was an early and successful worker in the field of adult education, his popular lectures in botany attracting many hundreds of people of the type which has the desire for learning but little opportunity of

acquiring a scientific training. His work covered a wide field; and in the performance of the duties associated with the Schools of Pharmacy and of Bakery he showed a marked gift for the expression of scientific subjects in simple language.

Prof. Ellis was widely known for his work on the iron bacteria and the sulphur bacteria, on each of which subjects he had published a monograph. In addition to his more recondite publications he contributed articles to the press on scientific topics and was the author of "Outlines of Bacteriology", "Guide to the Common Wild Flowers in the West of Scotland" and "Medicinal Herbs and Poisonous Plants".

Prof. Ellis's services were in demand as an expert on problems relating to the disposal of sewage, and frequently he figured as a consultant in law cases, when water pollution had led to litigation in which the interests of communities were involved. Such was his authority on this and kindred topics that he was consulted by Government departments including the Department of Health. His leisure time was divided between golf and the care of his garden, and it was while happily employed in his garden that he died. He is survived by two sons. J. P. T.

## Dr. W. V. Shaw, O.B.E.

DR. WILLIAM VERNON SHAW, a member of the medical staff of the Ministry of Health, died on January 21, aged sixty-three years.

Dr. Shaw had a brilliant career at Oxford, where he gained first-class honours in the final honour school of Natural Science, and at St. Mary's Hospital. He had a distinguished career in the public medical service first as medical officer of health for the Malton and Norton rural district, and later at the Ministry of Health. He was an expert epidemiologist and did valuable work for the Ministry in the investigation of outbreaks of infectious disease in many parts of the country. His diagnostic skill particularly of smallpox was widely recognized.

WE regret to announce the following deaths:

Prof. William Campbell, Howe professor of metallurgy in Columbia University, and an authority on physical metallurgy, on December 16, aged sixty years.

Dr. W. H. Collins, consultant to the Branch of Mines and Geology of the Canadian Department of Mines and Resources, and acting director of the National Museum, formerly director of the Canadian Geological Survey, on January 14, aged fifty-eight years.

Prof. Louis Mangin, director of the Marine Laboratory of the National Museum of Natural History, St. Servan, formerly professor of cryptogamic botany in the National Museum of Natural History, Paris, aged eighty-five years.

Prof. Bindo De Vecchi, since 1930 Rector Magnificus, and since 1925 professor of pathological anatomy of the University of Florence, on December 28, aged fifty-nine years.

Prof. R. L. Weighton, emeritus professor of engineering in Armstrong College, Newcastle-upon-Tyne, on February 19, aged eighty-five years.

## News and Views

Sir James Frazer, O.M., F.R.S.

At a dinner and reception given by Mme. M. Leonskaya at 2 Leinster Gardens, W.1., on February 17 in honour of Sir James Frazer and to celebrate his attaining the age of eighty-three years on January 1 last, Prof. B. Malinowski spoke in appreciation of his contribution to the study of man. After referring to the pre-eminent position long held by Sir James among anthropologists, he said that while such pioneers in the study of the early forms of religion as Mannhardt, Tylor and others looked to animism and the belief in spirits, Sir James was the first to indicate the place and junction of magic in primitive belief and to demonstrate the significance of magical practice and ritual in man's early conceptions of the universe. Further, that what Andrew Lang some twenty-five or thirty years ago flippantly termed "the Covent Garden school of anthropology", had become the fundamental principle in a great body of anthropological investigation into such beliefs as that of the spirit of fertility, the mother goddess and the like; while what was intended to be no more than a short essay of twelve pages dealing with the Priest of Nemi had grown into the twelve volumes of "The Golden Bough". Of all Frazer's great qualities, the most marked, as well as the most immediately striking, was his transparent and single-minded devotion to the cause of truth. He had never been so wedded to his own theories as to seek to impose them upon others in such a manner as to obstruct the attainment of the truth. He had never hesitated to abandon a theory which conflicted with further examination of the facts or fresh evidence, as was shown by the development of his views on totemism. In conclusion, Prof. Malinowski pointed out that, in principle, the studies upon which Sir James had been engaged were not confined to primitive man alone; they were equally applicable to our modern civilization—an application especially needed in the conditions of the world to-day.

### Native Policy in Northern Rhodesia

SOME important observations on policy, present and future, in the administration of native affairs in Northern Rhodesia were made by the Governor of that Dependency, Sir Hubert Young, when addressing the members of the East African group of the Overseas League at Overseas House on February 19. It was evident from his remarks that, while the cosmopolitan population of the mining area naturally is concerned primarily with the interests of copper, the most important industry in the country, the outlook on the native question is somewhat different in other districts. In a country in which there are one and three quarter million natives to eleven thousand Europeans, it is recognized, Sir Hubert said, that the

native has a right to have work most suited to him. Presumably it would be legitimate to interpret this as meaning, in less diplomatic terms, that the development of the native along lines in harmony with his own culture is to be the aim of administration, rather than the exploitation of labour solely to meet the needs of a European industry, important though this may be. An announcement, welcome in this connexion, was that an anthropological institute is to be established. This will ensure—or at least, so it may be hoped—that native custom and cultural trends will be studied thoroughly in order to meet the needs of administration. It will certainly afford an indispensable aid in the attempt which is now being made to re-establish the native organization and the native authorities. Sir Hubert Young expressed himself as "rather a heretic" in the matter of indirect rule. In view of the difficulties of re-establishing a system which now for some years has been in process of disintegration, it will perhaps be wise not to expect too much. At the same time, in regarding it as a training only, Sir Hubert wisely emphasized a fact often overlooked, that indirect rule cannot be an end in itself.

### Archæological Investigations in Western Asia

SIR LEONARD WOOLLEY, accompanied by members of his archæological expedition, left England on February 23 for Syria, where excavations will be resumed on sites in the Antioch region early in March. The personnel of the expedition includes Lady Woolley, Mr. E. A. Lane of the Victoria and Albert Museum, who was with Sir Leonard at Ur, and Mr. Murray Threipland, who was a member of the expedition last year. Work will be resumed on both the coast and the inland sites. Results from the latter will be awaited with special interest, in view of the significance of the evidence obtained last year from a preliminary examination of the site of Tell Atchana on the River Orontes, which, as Sir Arthur Evans has pointed out, when viewed in conjunction with the evidence from the other Syrian site of Ras Shamra and that from Palestine, for the first time carries the relation between this region of western Asia and Minoan Crete back so far as 1700 B.C. Further indications are not wanting that the diversion by circumstance of the preoccupations of archæologists from the Mesopotamian area to peripheral regions, which to many at first sight seemed deplorable, will have speedy and far-reaching beneficial effects. Especially worthy of note in this connexion are the recent discoveries of the Neilson Expedition of the University of Liverpool on Cilician sites at Serkeli (*The Times*, Feb. 13) and of Miss Winifred Lamb, whose report on recent developments in the pre-history of Anatolia was presented before the Society of Antiquaries on February 19.



MISS LAMB, before dealing with her own excavations on the newly discovered site at Kusura, which began in 1935, pointed out that recent archaeological investigations in Anatolia had deduced from the surface examination of prehistoric mounds and the excavation of two or three large sites, that during the Bronze Age two main cultures were to be distinguished, of which one, a western, had affinities with Troy, and the second, a central and eastern culture, was marked by the principal Hittite remains. Kusura lies on the southernmost of three routes from east to west of which one extends to Troy, the second to the coast near Smyrna, while the third, with which she was concerned, traverses the upland plains south of Afyonkarahissar. The town itself, it would appear, was occupied for the first time about the end of the fourth millennium B.C. A cemetery yielded pottery markedly local in character, unlike anything found elsewhere in Asia Minor. This strongly marked local character in the culture Miss Lamb found to persist even at the end of the Bronze Age, when there were signs of Hittite influence as well as of connexions with Troy. Further evidence relating to the 'indigenous' culture and its contacts with east and west will obviously be of considerable interest, especially in view of the results obtained by the Neilson Expedition at Serkeli, where also, judging from the preliminary report, there appears to be a strongly marked local culture. This is clearly of considerable antiquity, as it underlies levels which correspond with the earliest culture of El Obeid and Arpachiyeh in Mesopotamia. The stratum in question is said to be nine feet thick and to lie at a level of twenty-five feet below the Hittite levels. Its distinguishing feature is a peculiar painted pottery and plain pottery, while obsidian and flint were in use.

#### Promotion of International Equity

A PRELIMINARY outline of the proposals of the New Commonwealth Society for the creation of an equity tribunal for the settlement of non-justifiable disputes between nations is contained in a pamphlet, "An International Equity Tribunal", which has just been issued by the Society. It is urged that three institutions are required: (1) a body endowed with the legislative function and with the power to effect peaceful changes in the public law; (2) a court to interpret that law; and (3) a police force to uphold the decisions of the Court and to maintain law and order. The League of Nations is considered the foundation upon which the structure of an enduring peace is to be built, and these institutions should form part of its permanent machinery. By an equity tribunal is meant an impartial or neutral body which is called upon to investigate a political or industrial dispute, and the findings or awards of which are based upon natural justice. Consequently an international equity tribunal would be capable of effecting peaceful change in the public law, including the revision of treaties, and would be empowered to arbitrate upon all political disputes which cannot be settled by negotiation and conciliation. The members of the equity tribunal would require to

sever their connexion with the Governments and politics of their respective countries and devote their time exclusively to the service of the tribunal and of the League. An embryonic example of the working of an equity tribunal may be seen in the Lytton Commission, and a further stage towards the development of the tribunal system would be the creation of permanent committees by the Council or the Assembly in place of such *ad hoc* bodies.

It is suggested that the formation of an equity tribunal with a permanent and independent status, with members elected in the same way as the judges of the Permanent Court, is likely to provide the most effective machinery for the adjudication of political disputes and the revision of treaties. Its addition to the machinery of the League would disarm the assertion of certain non-members that the League is simply a vehicle for protecting and sponsoring special interests. The tribunal would be related to the Permanent Court, possibly as an independent division, with a personnel not consisting mainly of lawyers, and enforcement of its awards in the last resort would be secured by the existence of an international police force. The pamphlet is obtainable from the New Commonwealth Society, which has established itself as one of the most active organizations working in the field of international peace. Particulars of its work and conditions of membership can be obtained from the Secretary, Thorney House, Smith Square, Westminster, S.W.1.

#### Organization in Petroleum Research

RESEARCH is necessary in practically every phase of the petroleum industry to-day and, in view of its importance, should be prosecuted in the most efficient and economic manner possible. In a paper read before the Institution of Petroleum Technologists on December 8, J. H. Vermuelen discussed the organization of research. The main point to which he directed attention was that although decentralization is inevitable in every petroleum company owing to its very nature, yet its technical and administrative activities should be controlled and guided by a central laboratory. The laboratory should be so designed and equipped that routine and ordinary research can be carried out at the same time as applied and pure research and, while there should be no interference between the two types of research, yet there should be ample facilities for exchange of ideas. The routine function of the central laboratory should be to collect technical and commercial data from all branches of the company, systematize it and render it available in a convenient form for reference.

At the same meeting of the Institution, W. C. Asbury and D. A. Shepard threw further light on the organization of research by a description of methods adopted by the Standard Oil Co. (N.J.). Since its inception, sixty-five years ago, the company has been engaged continuously in research, and has had to meet the diversified interests and needs of several hundred subsidiary companies. Its technical

organization has grown on lines which combine centralization and decentralization. Problems peculiar to one operating unit are studied in laboratories controlled by that unit, but in addition all operating units are served by a commonly controlled central staff organization which incorporates research and development laboratories and co-ordinates the technical, scientific and patent activities of all units. Further, it has long been the practice of the company to support research programmes in special fields in university laboratories and to give recognition to the contributions to petroleum technology made by scientific workers and technologists. This is perhaps the most striking manifestation of the necessity felt by petroleum companies for some form of decentralization and external collaboration.

#### Calf of Man as Nature Reserve

MR. F. J. DICKENS of Silverdale, Carnforth, Lancashire, is presenting the Calf of Man to the National Trust. This gift should prove a very valuable addition to the island bird sanctuaries of the British Isles. The Calf, with the rocks to the south of it and Chicken Rock Light, have provided invaluable facilities for bird migration study, and as it is proposed to have the property managed by a committee of ornithologists and Manxmen, there is a unique opportunity for erecting another ringing station or bird observatory of the Isle of Man and Heligoland type there. Covering some 616½ acres, more than four hundred of which are healthy pasture, and including steep cliffs, a marsh, farm, ponds, a dam, and a glen, the Calf of Man as a bird reserve would preserve the nesting sites of some thirty species of bird including such birds as the chough which, declining in Cornwall and Devon, is increasing in the Isle of Man, the peregrine falcon, the shag, puffin, guillemot, razorbill, raven, kittiwake, rock-pipit, etc. There is a farm where a few house-sparrows, starlings, and blackbirds find a living, and wrens inhabit the caves. On migration, many warblers visit the Glen, etc., and forty-eight species of birds have been noted at the Chicken Rock Lighthouse (so named by sailors from the abundance of the storm-petrel or Mother Carey's chicken off that low rock). There may no doubt be need for some scientific control of the bird numbers, as in recent years the greater black-backed, lesser black-backed and herring gulls have increased their nesting areas, and these rapacious birds are often a danger to more interesting, but less vigorous, species. The flora has not been worked so thoroughly, but some three hundred or more plants occur, including the yellow-petalled 'ochrocyanea' variety of wild radish near the farm, wild hyacinth in a curious marshland habitat near the landing Sound, and sundew.

#### Bird Migration and Air Currents

At the annual conference of the International Faculty of Sciences, held in London on January 29-30, Capt. B. Acworth presented a paper entitled "New Light on Bird Migration". But the paper contains nothing of importance that was not set down lucidly and with similar diagrams in his "This

Bondage" in 1929. There is the same useful insistence upon the effects of wind currents upon the movements of birds, and alas, the same errors are repeated. For example, Capt. Acworth insists that the permanent winds of the tropics form impassable barriers; that consequently "the species of birds found in particular temperate zones must have had *separate origins*"; and that these facts "seem to demolish . . . the theory of evolution as it affects the common origin of birds." But surely the fact that every autumn and spring in the Old World and the New birds do actually cross, as a matter of routine, the "impassible barrier" of the equatorial currents demolishes the whole argument. Again, the exact knowledge of the writer of the Book of Exodus in describing how "the east wind brought the locusts" is contrasted with the ignorance of biologists, anatomists and embryologists; but records of insect migrations show that the wind is not the directive factor in a large percentage of cases. Lastly, "seasonal winds have always ensured the translation of birds to parts of the world agreeable to the essential needs of the appropriate species", which, if it means anything at all, means that wind and no biological factor has settled the agreement between birds and their environment.

#### Agriculture in Tanganyika

THE annual report of the Department of Agriculture in Tanganyika for 1935 has now been published (Dar-es-Salaam: Government Printer, 1936). From the economic point of view, the past five years have been the most critical in the history of the Territory, and 1935 can be regarded as the culminating point of the effort to place it in a position of economic security. The volume of total exports attained has never before been approached, in spite of the fact that record figures for most crops had been reported during the four previous years. In the year under review, records for the export of the three premier industries, sisal, cotton and coffee, have been achieved, while high figures are again reported for ground-nuts, bees-wax and sesame. Copra alone has yielded disappointing results. The soundness of the policy of increasing production in a territory which has not reached the limits of development seems to have been vindicated, as the standard of living and purchasing capacity of the native peoples have been markedly improved, and also a rise in the value of exportable commodities obtained. As regards non-native agriculture, the excellent price secured for sisal-hemp stimulated the rejuvenation of estates, re-equipment of factories and a general re-organization of the industry. Much too large a proportion of planters, however, still rely on a one-crop policy, and the adoption of a more diversified farming is advocated. Native development is making sound progress, successful concentration of population now being possible in districts which quite recently were poverty-stricken tsetse areas. Questions of irrigation and natural water supplies play a vital part in African life, and important developments are already in hand following the recommendations of the special inquiries completed during the year under review.

### Progress in Grass Drying

At the second Congress of Mechanised Farming held at Rhodes House, Oxford, on January 5-8, when recent developments were described, a paper by Mr. E. J. Roberts on "A Year's Progress in Grass Drying" excited much interest. A résumé of this paper is published in *Engineering* of February 5. The author points out that whereas there were only six driers in operation in 1935, there were 46 by the end of the 1936 season. The engineering difficulties in connexion with drying plant have been successfully overcome. This is confirmed by papers at the Congress giving the experience of users. We know that inventors are busy developing new methods and rapid progress in this direction will doubtless soon be made. For the year just closed it is expected that the production will be 10,000 tons. In the United States for the same period, it was 50,000 tons. In countries abroad the usual practice is to dry the grass in large centralized units. In Great Britain, in general, only small localized units are used. This is a pity as it is not the most economical method. In a paper read at the conference by Prof. J. A. Scott Watson, it was shown that the remaining problems are to bring down the cost of the drying plant, the fuel cost and the labour cost and to increase the output. Mr. Roberts in his paper stated that one large drier evaporated 9 cwt. of water with 1 cwt. of coal for a short period and worked at a normal figure of 8 cwt. Smaller driers give efficiencies of  $3\frac{1}{2}$ - $5\frac{1}{2}$  cwt. of water per cwt. of coke. If we take the calorific value of the coal to be 14,000 B.Th.U. and that of the coke to be 13,000 B.Th.U., the advantage lies greatly in favour of the large drier.

### Testing Broadcasting Receivers

At an informal meeting of the Wireless Section of the Institution of Electrical Engineers held in November 1935, Dr. R. L. Smith-Rose opened a discussion on the methods of examining the performance of wireless sets used for the reception of broadcasting. No specification was then available of the standards of performance at which it was desirable to aim in the production of such receivers. Quite recently, however, the Radio Manufacturers Association has published a "Specification for Testing and Expressing Overall Performance of Radio Receivers", and a discussion on this specification was opened by Mr. Stuart Hill at a meeting of the Wireless Section of the Institution of Electrical Engineers held on February 3. The above specification is in two parts, dealing respectively with electrical and acoustic tests. The first part describes laboratory methods of measuring the sensitivity and selectivity of a receiver, and also its susceptibility to noise and the performance of its automatic volume control. The second part describes the corresponding methods of measuring frequency response, acoustic sensitivity, hum and acoustic output. In each case the proposed methods of expressing the results are described and illustrated by means of typical graphs included in the specification.

THE discussion at the Institution indicated that the initiative shown by the R.M.A. in producing this specification is very generally appreciated, although some criticism was offered on matters of technical detail. In so far, however, as Mr. Hill stated, the specification has been drawn up by manufacturers for manufacturers, its useful purpose is somewhat limited at the present time. Furthermore, it does not contain a suggested standard of performance, and this might very usefully be added after consultation with representatives of the users of such receivers and of the B.B.C. and other Government departments interested in the matter. In fact, the time would now seem to be opportune for such a body as the British Standards Institution to take up the subject by setting up a representative committee for the purpose of drafting a specification dealing not only with methods of testing, but also with the standards of performance to be attained by the various types of modern radio receiver. Such a standard specification has long been needed; it would be of great benefit to the radio industry as well as to the general public; and the labours of the drafting committee will now be considerably lightened by the pioneer work already accomplished by the Radio Manufacturers Association.

### Standards of Radio Frequency

MODERN electrical measurements are conspicuous for the fact that the frequency of alternating currents can be measured to a very high order of accuracy. In order to provide a standard of frequency for scientific and technical workers, the National Physical Laboratory undertakes the emission of two types of frequency of reference from its own radio transmitting station. One of these is in the form of a modulation frequency of one kilocycle per second superimposed on a carrier wave of 396 kilocycles per second, while the other is a simple carrier wave of frequency 1,780 kilocycles per second. The programme incorporating the first frequency is emitted on the second Tuesday of each month at 10.40-12.00 G.M.T., while the second is emitted on the first Tuesday in March, June, September and December at 21.00-22.00 G.M.T. The modulation frequency employed in the first programme is derived from one or other of two oscillators, which are maintained in continuous operation at the National Physical Laboratory. One of the oscillators is an electrically maintained tuning fork vibrating at its natural frequency of 1 kilocycle per second; while the other is a quartz ring oscillator generating a frequency of 20 kilocycles per second, with the necessary attachment for selecting the required frequency of one twentieth of this value. In both cases, the accuracy with which the frequency is maintained is one or two parts in 10 million, but during each emission the exact frequency is measured at the Laboratory, and the correct value is announced at the end of the programme. For the second standard frequency emission, a separate quartz crystal oscillator is employed; in this case, no correction is announced, the frequency emitted being accurate to within one part in a million. A revised programme giving full

details of these transmissions can be obtained on application to the Director, National Physical Laboratory, Teddington, Middlesex.

### Lead Sheaths of Electric Cables

LEAD is a very suitable metal for providing a water-tight covering to an electric cable buried in the earth. The weight of the lead sheaths made per annum in Britain alone is 64,000 tons. Taking into account the much larger quantity that must be used in the many cable factories throughout the world, it will be seen that an improvement in the technique of the manufacture of lead sheaths is one which seriously concerns both users and manufacturers. Of recent years, much thought has been given to this problem and very many patents have been taken out for improvements. In a paper by Dr. P. Dunsheath, read to the Institution of Electrical Engineers on December 3, a method for the continuous extrusion of lead sheaths over cables is described which is being widely adopted by manufacturers. Hitherto, the extrusion of the lead has been done by the ram of a hydraulic press. In Dr. Dunsheath's method, the pressure required to extrude the lead is obtained by means of a motor-driven screw member. In 1929 the first lead pipe was extruded by a continuous process, and the development has continued steadily up to the present. A defect of cable sheaths made on hydraulic presses is the inclusion in the finished pipe of welds between separate faces of metal, which at some stage in the process have been exposed to the air and therefore become slightly oxidized. Provided sufficient time is allowed to elapse and sufficient pressure applied at a sufficiently high temperature, two separate masses of lead will weld together completely into one homogeneous mass if the faces are clean and free from oxide.

### Air Raid Precautions and Air Disarmament

A PAMPHLET entitled "Defence that is no Defence", by Dr. C. E. M. Joad, issued by the National Peace Council, directing attention to the inadequacy of the Government proposals for defence against air raids and the impossibility of devising any adequate protection against simultaneous attack by gas, explosive and incendiary bombs, quotes the warning against this barbarous perversion of science and industry in the tendency to accept the use of aircraft for unrestricted bomb and gas attack on civilized populations uttered by leading scientific workers when the Government schemes were first introduced. Subsequent events have only confirmed the prediction that acceptance of this position must rapidly lead to the breakdown of civilized life. Dr. Joad, while emphasizing the futility of the measures so far proposed by the Government and also the difficulty of its position, urges that the Government should work strenuously for abolition of the bombing aeroplane and for disarming in the air and placing civil aviation on an international basis, as affording the only security against destruction of our cities by attack from the air. He also urges a policy directed towards the removal of economic tensions which are

endangering peace, and suggests a definite lead from Great Britain in regard to access to raw materials and equalizing of opportunities for trade which might be provided by an extension of the mandates system, the lowering of tariffs and removal of economic barriers.

### Scientific Management and Economic Problems

IN an address to the Engineers' Study Group on Economics on January 19, Major L. R. Urwick spoke on the contribution of scientific management to the solution of present economic difficulties. He outlined the development of the principles of scientific management from the pioneer work of Charles Babbage and F. W. Taylor to such recent manifestations as "Stakhanovism" in Russia. Scientific management means essentially not the multiplication of efficiency experts but the adoption by both employers and employed of a new mental outlook, based on exact measurement and not on opinion, and more interested in increasing the output of industry than in haggling about its division. Resistance to Taylor's ideas had largely been due to those of his followers who had adopted his methods piecemeal while neglecting the underlying philosophy. Scientific management has spread much faster on the productive side of industry than on the distributive, or in finance, and the machinery of Government has also profited far less than it should have from the available knowledge of management problems. The first part of a chapter on "The Division of Labour and the Pricing System" has recently been forwarded in draft, and the chapter on "Money and Banking" has been discussed at a recent meeting of this Group.

### Analytical Control of Foods and Drugs

Extracts from the annual report of the Ministry of Health and abstracts of reports of public analysts upon the analytical control of foods and drugs for 1935 have been issued as a separate pamphlet (Sale of Foods and Drugs. H.M. Stationery Office, 1936. 3d. net). No less than 143,831 samples were analysed by public analysts in England and Wales, of which 7,972, or 5.5 per cent, were reported against. The number of samples of milk examined was 78,674, of which 5,798 samples were reported to be adulterated or not up to standard. Several samples of canned products were found to be contaminated with tin, lead, copper or zinc. A few samples of sugar contained sand, and one of icing sugar rancid fat and dead flies. Adverse reports were made on a number of 'cream' cakes and pastries on the ground that the filling consisted wholly or partially of fat other than milk fat, and a number of 'chocolate' rolls and cakes contained no chocolate. The reports of the public analysts are abstracted in a series of tables.

### National Institute for Research in Dairying, Reading

IN the annual report for 1935 of this Institute, which has recently been issued, the research and other activities are summarized. The research work includes such varied subjects as winter feeding of young dairy cattle and artificial insemination of

cows, investigations on the chemical composition of typical milk and of taints of milk, the lactic acid bacteria and cheese-ripening studies, and on pasteurization and tubercle bacilli in milk. Cases of contagious abortion among the Institute's herd of cows gave an opportunity for investigating *Brucella abortus* infection. Bacteriological testing of milk samples and market milk investigations have also been carried out, and the phosphatase test for efficiency of pasteurization has been re-examined. The financial condition of the Institute is considered, and an appeal is made for further funds to enable an extension of the work to be made.

### Oxford and Present Needs in Science

REFERRING to the leading article in NATURE of February 20 under this title, a correspondent writes as follows: "As some readers may not be familiar with the names given to certain buildings in Oxford, it may be helpful to state that the 'Ashmolean Museum' now means the Museum of Art and Archaeology, chiefly classical, established in Beaumont Street in 1890, whereas the 'Museum of the History of Science' means the ancient scientific collections in the Old Ashmolean Building, which was the only science museum from 1683 until 1860. In this building Ashmole's old museum room is now full to overflowing of historic instruments and specimens; and money is needed for its extension. The changes contemplated in the various scientific departments of the University make it more than ever necessary to provide for the preservation of things of historic value that might otherwise be scrapped".

### Early Man in Minnesota

PROF. A. E. JENKS, of the University of Minnesota, reporting recently on "Minnesota man", a female skeleton found in ancient lake deposits in 1931, attributes to it an age of approximately 20,000 years, and regards it as the oldest specimen of early man to be found in America. The teeth had all erupted, with the exception of the wisdom teeth, but as the long bones appear to be still immature, the age of the girl was probably about fifteen years. The teeth are larger than normal in prehistoric man. In summing up the characters of the skeleton, Prof. Jenks, it is stated by Science Service, regards it as *Homo sapiens*, of an early type of evolving Mongoloid, forecasting the aboriginal American, especially the Eskimo, rather than the modern Mongol. It has been computed that the Lake Pelican deposits, in which the skeletal remains were found, antedate those of the glacial Lake Agassiz by some two thousand years, thus warranting this increase in the age usually admitted for early man on the American continent.

### Sanitary Aviation in Soviet Russia

THE sanitary aviation service maintained by the Red Cross and Red Crescent Society of the U.S.S.R. is fast becoming a regular institution for medical aid, particularly in outlying regions of the Union. Sanitary aeroplanes are kept in readiness in all parts of the Union to answer urgent calls for medical aid. In

1936, more than 400 patients were carried by air to hospitals and more than 500 specialists were taken by air to various places where they performed some fifty major operations and treated about four thousand seriously ill persons. In 1936 also, the sanitary aeroplanes of the Red Cross and Red Crescent Society carried more than 2,000 kilograms of medical supplies to different points of the Union.

### Biochemistry in the U.S.S.R.

WE have received the first five numbers of the first volume of a new Russian journal, devoted to biochemistry. It is entitled *Biochimia*, and is edited by A. N. Bach and W. A. Engelhardt. The papers are in Russian, but each is provided with a summary in English or German. The average size of each number is about 120 pages. The papers deal with work on vitamins, enzymes and other biochemical problems. The journal should enable workers in other countries to gain some idea of the work which is being carried out in Russia in biochemistry.

### Comets

A NEW comet was discovered by Dr. F. L. Whipple at Harvard on February 7. Its magnitude was 12 at the time of discovery, and it was described as diffuse with a central condensation, and a tail less than 1° in length. Dr. Whipple computed the following parabolic orbit:

<i>T</i> 1937	Jan.	22.070	U.T.	
$\omega$	111°	27	}	1937.0
$\Omega$	127	4		
<i>i</i>	41	4		
<i>q</i>	1.6610			

It is now about 1.5 units from the earth, which it is approaching, but it is not likely to become a conspicuous object. Mr. Simizi in Japan detected Daniel's Comet, 1909 iv, 1937 a, on January 31. Its magnitude was 13 and it was diffuse without any central condensation. Mr. Hirose computed an orbit the elements of which are given below. It is receding from the earth, and is now more than 1.4 units distant.

<i>T</i> 1937	Jan.	27.940	U.T.	
$\omega$	6°	1'	}	1937.0
$\Omega$	70	19		
<i>i</i>	19	50		
<i>q</i>	1.537			
	Period 6.825.			

### The Night Sky in March

DURING March, the duration of night in the latitude of London decreases by nearly two hours. On March 21<sup>d</sup> 1<sup>h</sup> the sun enters the sign Aries (Spring Equinox). The moon is new on March 12<sup>d</sup> 19.5<sup>h</sup> and full on March 26<sup>d</sup> 23.2<sup>h</sup>. No bright stars are occulted during the month, but the following disappearances may be noted: 108 Tauri (mag. 6.2) on March 18<sup>d</sup> 19<sup>h</sup> 39.0<sup>m</sup> when the moon is 6 days old, and *e* Leonis (mag. 5.1) on March 25<sup>d</sup> 21<sup>h</sup> 54.4<sup>m</sup>, the moon being 13 days old. The planet Venus, which does not set until about 22<sup>h</sup>, is a striking object and reaches its greatest brilliancy on March 12; the area of the illuminated crescent is then 0.28 that of the whole apparent disk. Mercury, being in superior conjunction with the sun

on March 16, is not accessible to observation. Mars rises at about midnight and is about  $1\frac{1}{2}^\circ$  preceding the third magnitude star,  $\beta$  Scorpii. The planet brightens during the month from  $+0.4^m$  to  $-0.3^m$ , its greatest brightness being reached in May. Jupiter, of stellar magnitude  $-1.6$  to  $-1.7$ , will be found low down in the morning sky. Saturn, being in conjunction with the sun on March 16, is above the horizon almost wholly in daytime. On March 8, Neptune (mag. 7.7) in Leo is in opposition; the planet's distance from the earth will then be nearly 2,714 millions of miles. The zodiacal light may be looked for on clear evenings after sunset at the beginning and end of the month. On or about March 3 and March 30, the night sky may also be scanned for any appearance of the aurora; auroras were observed 27 and 54 days earlier in northern England and Scotland respectively, and this 27-day sequence may possibly be continued in March. In any event, auroral displays may now be looked for generally on account of the active state of the sun, and there is also a higher frequency of magnetic disturbances at about the equinoxes. The following positions at 0<sup>h</sup> U.T. of Comet Whipple (1937 *b*) are given in Circular No. 636 of the *Bureau Central des Télégrammes Astronomiques*:

	R.A.		Dec.	
	h	m	°	'
March 4	13	49.9	+45	42
" 8		54.3	47	25
" 12		58.3	49	6
" 16	14	1.8	50	44

#### Announcements

THE new ultra-centrifuge in the Department of Biochemistry of the University of Oxford will be inaugurated at 4 p.m. on February 27. The Vice-Chancellor of the University, the president of the Royal Society and Prof. The Svedberg, of the University of Uppsala, will be present.

At the annual general meeting of the Quekett Microscopical Club, held on February 9, the following officers were elected: *President*, W. E. Watson Baker; *Vice-Presidents*, E. A. Robins, J. T. Holder, Dr. C. Tierney, and Chetwynd Palmer; *Treasurer*, C. H. Bestow; *Secretary*, W. S. Warton; *Reporter*, A. Morley Jones; *Librarian*, W. E. Stone; *Curator*, C. J. Sidwell; *Editor*, W. P. Sallis. *New Members of Committee*: F. C. Grigg, N. I. Hendey, A. E. McClure, F. E. J. Oekenden, C. C. Swatman.

At a meeting of the president and fellows of Harvard College in Boston, held on January 18, it was voted "that the thanks of the President and Fellows be sent to Sir Robert Hadfield for his beautiful and welcome gift of a picture appropriately commemorating in this University the University of Oxford, with which during a period of three hundred years Harvard has enjoyed close associations; and that the picture, with the accompanying gifts of books, scientific papers and other mementos, be gratefully accepted and duly recorded in connection with the recent observance of the Tercentenary of Harvard College". (A note on the picture in question,

which gives an unusual view of Oxford from the Sheldonian Theatre, appeared in NATURE of December 12, p. 1005.)

IN conjunction with its annual general meeting in May 1938, the Iron and Steel Institute is to organize a symposium on "Steelmaking". Particular attention will be given to acid and basic open-hearth processes. Further information can be obtained from the Secretary, Iron and Steel Institute, 28 Victoria Street, London, S.W.1.

A DAVID ANDERSON-BERRY GOLD MEDAL, together with a sum of money amounting to about £100, will be awarded in July 1938 by the Royal Society of Edinburgh to the person who, in the opinion of the Council, has recently produced the best work on the nature of X-rays in their therapeutical effect on human diseases. A similar award will be made every three years. Applications for this prize are invited. They may be based on both published and unpublished work and should be accompanied by copies of relevant papers. Applications must be in the hands of the General Secretary, Royal Society of Edinburgh, 22 George Street, Edinburgh 2, by June 1, 1938.

THE Annual Malaria Control Course for Laymen will be held at the Ross Institute of Tropical Hygiene, Keppel Street (Gower Street), London, W.C.1, commencing on June 21, at 10 a.m., under the direction of Sir Malcolm Watson, director of the Institute. The course lasts five days, and is designed for planters and mining engineers, but it will be of interest to all (including missionaries) who are proceeding to the tropics. Application to attend the course should be sent in as early as possible to the Organizing Secretary at the above address. Admission is free.

THE Medical Society of Vienna will celebrate the centenary of its foundation in conjunction with the Union for Postgraduate Instruction on May 19-29.

THE next congress of the Society of German Men of Science and Medicine will be held at Stuttgart in 1938.

A NATIONAL medical council on birth control has been formed in the United States to control and supervise medical policies of the American Birth Control League, and to initiate, encourage and carry out appropriate scientific research in the medical aspects of birth control.

THE American Association for the Study of Goitre offers the Van Meter Prize of 300 dollars and two honourable mentions for the best essays on experimental and clinical investigation of the thyroid gland. The award will be made at the next annual meeting of the Association, which will be held at Detroit, Michigan, on June 14. The MSS., which should not exceed 3,000 words, must be presented in English, and a type-written double-spaced copy sent to the secretary, Dr. W. Blair Mosser, 133 Biddle Street, Kane, Pennsylvania, not later than April 1.

## 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. 376.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Effects of Traces of Metallic Ions on Films at Interfaces and on the Surface of Water

It appears advisable at this time to direct the attention of workers in the field of surface chemistry to recent work on the effects of minute traces of metallic ions on the behaviour of monomolecular films on the surface of water, since serious consideration of such results brings into question some of the data published on monomolecular films, particularly those data on films formed by substances with acidic groups in the molecule, spread on a neutral or basic aqueous layer.

Early in 1935, while at the Johns Hopkins University, one of us (R. J. M.) noticed an apparently abnormal behaviour of monomolecular films of palmitic acid on fresh distilled water. A heavily paraffined brass trough and a film-balance of the Langmuir type were used. It was found that when water was distilled directly from a quartz still into the trough, and a force-area determination made on the palmitic acid within a few hours after the distillation, quite expanded *liquid* films were obtained ( $a_0 = 25.0 \text{ A.}^2$ ), which collapsed at relatively low pressures. If, however, the water were allowed to stand overnight in the trough, or if the distillate had been first caught in glass vessels, the usual *solid* condensed films ( $a_0 = 20.5 \text{ A.}^2$ ) were obtained. The effect of the glass vessel was correctly attributed to minute traces of calcium ions, but the contamination of zinc and copper ions from the paraffined trough was unfortunately overlooked. The peculiar behaviour of palmitic acid had been noticed earlier by Adam<sup>1</sup>, who also was at a loss to account for the difference between what he called 'old' and 'fresh' distilled water. Due to the press of other work, the experiments were not continued further at the Johns Hopkins University, but have been resumed at the University of Chicago, where the troughs now in use are plated with gold, rhodium, or both, while the newer apparatus is being constructed of quartz.

Such effects have been known for years, as in the remarkable action of calcium ions on the interfacial tension between solution of oleic acid in benzene and sodium hydroxide solutions, found by Harkins and Zollman in 1925<sup>2</sup>; these effects are due to the formation in the film of various mixtures of the organic acid with its sodium and calcium or other similar soaps. The phenomenon was discovered by Bancroft and Clowes<sup>3</sup> in their work on the inversion of emulsions.

Recent work by Langmuir, Schaeffer and Miss Blodgett<sup>4</sup> has apparently identified the curious results of Myers with the formation of mixed copper and zinc soaps, caused by solution of the brass trough, though heavily paraffined. Langmuir has also indicated that minute traces of calcium ions convert

stearic acid films into calcium stearate, as a result of which the area per molecule is 20 sq. A. as compared to a very large area on dilute sodium hydroxide. Also, they find that the films are solidified upon the addition of calcium, a fact noted earlier by Harkins and Zollman.

While Langmuir has *implicitly* emphasized the effect of dissolution of the brass trough upon the characteristics of monomolecular films, it appears worth while to point out the great significance of these effects of minute traces of metallic ions in some of the published or unpublished work on monomolecular and polymolecular films.

First, it seems reasonable to expect similar startling differences in the behaviour of films when proteins, lipoids and similar substances are examined. Thus, in the interpretation of published work, it is necessary to qualify conclusions regarding the behaviour of fatty acids, lipoids and proteins, when films of these substances have been examined near the neutral point or on the basic side of their isoelectric point, unless troughs of quartz or similar material have been used, and chemicals, free from bivalent or trivalent impurities, have been employed. In particular, unless suitable precautions have been taken, such films should be referred to not as 'stearic acid' or 'protein', but as "mixed copper and zinc (or calcium) stearates", and 'mixed proteinate'.

Secondly, in the future, research workers who examine films of molecules which contain acidic groups should operate in quartz, or at least *very* heavily paraffined glass troughs. Further, salts used in the substratum should be exceedingly pure, in order that the phenomena which are observed may not be caused by spurious quantities of bivalent or trivalent ions. In view of the expensive nature of quartz and the ease with which metal apparatus may be fashioned, we have undertaken, together with an extensive study of these ionic effects, a study of various electrodeposited metals to determine whether troughs other than quartz may be used without error. Preliminary experiments conducted by us have indicated that under certain conditions even paraffined glass vessels may contaminate solutions contained in them. At Cornell University, Nutting, Long and Harkins are beginning work with troughs made wholly of paraffin.

Thirdly, it may very well be that the negative results of many experimenters who have tried to correlate surface activity with other variables, such as hydrogen ion concentration, have been caused by the formation of insoluble calcium or copper compounds due to the presence of traces of these ions in the substratum. All studies on interfacial tensions in systems containing substances of this character must be qualified due to the presence of calcium ions

from the glass apparatus employed. It is quite possible that there will be found a remarkable difference in the contact potentials of films, when great care has been exercised to remove these interfering ions.

In fact, only when strongly acid solutions have been employed, can we be reasonably certain that the presence of calcium or similar ions in the substratum has had no influence on the behaviour of the film. Gorter<sup>5</sup> has found large differences in the area per molecule of ovalbumin films when sodium or calcium ions are present in the substratum. From other papers of Gorter, in which a glass trough was used, it appears reasonable to conclude that this work was also done in glass.

ROBERT J. MYERS.

WILLIAM D. HARKINS.

Department of Chemistry,  
University of Chicago.  
Jan. 4.

<sup>1</sup> Adam, N. K., *Proc. Roy. Soc., A*, **99**, 336 (1921).

<sup>2</sup> Harkins, W. D., and Zollman, H., *J. Amer. Chem. Soc.*, **48**, 69 (1926).

<sup>3</sup> Clowes, J. *Phys. Chem.*, **20**, 408 (1916).

<sup>4</sup> Langmuir, I., *J. Franklin Inst.*, **218**, 143 (1934). Langmuir, I., *Science*, **84**, 379 (1936). Blodgett, K., *J. Amer. Chem. Soc.*, **57**, 1007 (1935). Langmuir, I., and Schaeffer, V. J., *J. Amer. Chem. Soc.*, **58**, 284 (1936).

<sup>5</sup> Gorter, E., *J. General Physiology*, **18**, 421 (1935). Gorter, E., and Grendel, F., *K. Akad. Wetensch. Amsterdam*, **32**, 770 (1929). Gorter, E., *K. Akad. Wetensch. Amsterdam*, **37**, 20 (1934). Gorter, E., and Grendel, F., *Trans. Far. Soc.*, **22**, 477 (1926).

### Glucolysis without Phosphorylation in the Chick Embryo

DURING the course of last year, a preliminary communication<sup>1</sup> in these columns gave an account of experiments on the chick embryo in the first week of its development, which suggested that glucolysis proceeds in these young tissues without phosphorylation. We wish now to give further details strongly indicating that this is so.

As was there reported, the embryo exhibits a marked substrate-preference, attacking glucose and mannose, but not glycogen or the phosphorylated hexoses. When phosphorus-transporters such as adenylic acid or cozymase are added to embryo (intact or *Brei*) in presence of glycogen or hexosediphosphate, a certain breakdown of these substrates may occur, but it is always small, transient, and not regularly demonstrable. Nevertheless, aldolase (zymohexase), which converts hexosediphosphate into triosephosphate, is present in as active a form in the chick embryo as in mammalian muscle extract. Hence triosephosphate accumulates steadily so long as the experiment lasts. The failure of the embryo to carry hexosediphosphate breakdown further than this cannot be remedied by addition of cozymase and pyruvate; it must therefore be due to lack or inefficiency of the enzyme system effecting the change.

However, all the enzymes concerned in the breakdown of phosphoglyceric acid are present in the embryo. Dephosphorylation of phosphopyruvic acid by adenylic acid is found in full strength in the earliest stage examined (23rd hour), before the neural folds have closed. The Parnas reaction, however, occurs in full strength only from the 43rd hour (beginning of cardiac activity). Only creatine phosphate, never arginine phosphate, is formed. Esterification of glycogen can at no stage be demonstrated. All the enzymes of phosphorylation which could be

demonstrated in the embryo at all could be had in cell-free extract, in sharp contrast to the glucoytic system proper. This fact is important when conclusions on glucose breakdown are drawn from the behaviour of extracts of muscle or brain.

The rate of glucolysis itself, on the other hand, cannot be affected by the addition or removal of any of the phosphorus-transporters. Nor could any esterification of glucose be observed in a wide variety of conditions. The relation of fluoride concentration to inhibition is also different according to the system studied. Thus at *M/200* sodium fluoride, the conversion of phosphoglyceric to phosphopyruvic acid is completely suppressed, while the glucolysis of the same *Brei* at the same time is only 40 per cent inhibited. Inhibition by *dl*-glyceraldehyde is powerful and specific; it is not shown by other aldehydes (for example, propionaldehyde, pyruvic aldehyde, etc.). By dialysis of embryo *Brei*, glucolysis may be inactivated. It may then be restored up to 80 per cent by the addition of rather large amounts of glutathione (cf. the work of Geiger<sup>2</sup> on adult tissues), larger amounts than are required for the reactivation of methylglyoxalase. Further, if glucose and synthetic methylglyoxal, in sufficient amounts to saturate the enzymes, are suddenly given together to a fresh embryo *Brei*, the subsequent summation of lactic acid formation which occurs is almost perfect. Methylglyoxal, as obtained by chemical synthesis, is therefore not an intermediate in embryonic glucolysis.

The two routes of breakdown may be further elucidated by the combined use of hexokinase (the enzyme of yeast which phosphorylates glucose), and fluoride or glyceraldehyde. In all cases, inhibition by these substances is of the same order whether hexokinase is present or not. Glucose could never be shunted into the phosphorylation route, even by the addition of hexokinase to embryo *Brei* in which the cell integrity had been abolished.

All these facts, and those summarized in the previous communication, are brought together by the hypothesis that in the chick embryo there are two separate routes of carbohydrate breakdown:

(i) A non-phosphorylating glucoytic mechanism, very active, and closely bound to the cell-structure, in which

- (a) glutathione is necessary;
- (b) methylglyoxal, dioxyacetone and glycerol are not intermediates.

(ii) A phosphorylating mechanism closely similar to that in muscle, dealing with glycogen and hexosediphosphate, but of low activity because deficient at four distinct places:

- (a) the enzyme esterifying glycogen;
- (b) the enzyme system dismuting triosephosphate with pyruvate to phosphoglyceric and lactic acids;
- (c) lack of adenylypyrophosphate;
- (d) lack of cozymase.

It would thus appear that in early embryonic development the phosphorylation machinery has not yet been fully laid down, and it is of interest that a similarly incomplete system has been described for some tumours<sup>3</sup>. Whether the non-phosphorylating glucolysis here described is the same as that suspected<sup>4,5</sup> in adult tissues such as brain, heart muscle, etc., remains for further investigation.

Lastly, attention may be directed to a correlation which seems to exist in embryo, brain, tumour, etc., between (i) relatively high anaerobic glycolysis,



(ii) preference for glucose as substrate without the addition of hexokinase, (iii) sensitivity to glycer-aldehyde inhibition, (iv) inefficiency of phosphorylation, (v) the Pasteur effect without the Meyerhof cycle.

JOSEPH NEEDHAM.

Biochemical Laboratory, HERMANN LEHMANN  
Cambridge.

Jan. 27.

<sup>1</sup> Needham, Nowinski, Cook and Dixon, NATURE, 138, 462 (1936).

<sup>2</sup> Geiger, Biochem. J., 29, 811 (1935).

<sup>3</sup> Tsuzuki, (Jap.) J. Biochem., 23, 421 (1936).

<sup>4</sup> Haarmann, Biochem. Z., 255, 142 and 203, 256, 236 (1932).

<sup>5</sup> Ashford and Holmes, Biochem. J., 23, 748 (1929).

### Rate of Tissue Metabolism of Marine Cold-blooded Animals in Different Latitudes

IN previous communications to NATURE<sup>1</sup> the activities and metabolism of arctic and English marine invertebrates were compared. It was shown that English species consume more oxygen, at the temperatures at which they live, than nearly related arctic species at the lower temperatures of their habitats. Since the locomotory activities of the English species are apparently no greater than those of their arctic cousins, the hypothesis was proposed that the greater oxygen consumption of the former is due to a greater non-locomotory metabolism. We have now tested this hypothesis for prawns living in the two waters by measuring the oxygen consumption of thin isolated muscles as well as that of the whole animals. The dorsal extensor muscles of the abdomen were used.

But for *Pandalus montagui* from Kristineberg the situation is not so clear. Fig. 1 shows that while the oxygen consumption of its isolated muscles is almost identical with that of the muscles of *P. borealis*, the oxygen requirements of whole animals of the former species are almost double those of the latter. This suggests greater activity. Indeed the oxygen consumption of whole animals of *P. montagui* at the low temperatures of Kristineberg is seen to be as great as, or greater than, that of the same species at the higher temperatures of Plymouth.

In other ways, too, *Pandalus montagui* from Kristineberg behaves as a different physiological variety from the same species at Plymouth. The heart and scaphognathite rates at Kristineberg and at Plymouth show differences parallel to the oxygen consumptions of the whole animals in the two localities. Moreover, the Kristineberg variety will not survive an aquarium temperature above 11°, whereas the Plymouth form can be kept alive at 17°.

These results will be published in the *Proceedings of the Zoological Society*.

H. MUNRO FOX.

C. A. WINGFIELD.

Kristinebergs Zoologiska Station,  
and University of Birmingham.

<sup>1</sup> H. Munro Fox, NATURE, 137, 903 (May 30, 1936); and 138, 839 (November 14, 1936).

### Effect of Ultra-centrifuging on the Egg of *Ascaris megaloccephala*

EGGS of *Ascaris megaloccephala* (= *equorum*) var. *monovalens*, like those of *Ascaris suum*<sup>1</sup>, may develop normally after being subjected in the uncleaved condition to great centrifugal forces over long periods.

However, cytological examination of eggs which have been kept in the air turbine ultra-centrifuge at 150,000 times gravity until after control eggs have undergone several cleavages, shows that the nucleus has divided, but no cleavage of the cytoplasm has occurred. If one cleavage has been suppressed, there are four centrosomes and four chromosomes in the egg cell at the next metaphase (Fig. 1). In most of such cases the chromosomes are undiminished, but frequently diminution has occurred (Fig. 2). Such tetrapolar mitoses usually result in four cells, in all of which chromatin diminution has taken place before the next division is completed. Very rarely, the cleavage planes are so oriented that one of the resulting cells contains most of the material from the animal pole of the egg; chromatin diminution may take place in this daughter cell but not in the others. If two cleavages have been suppressed, there are eight centrosomes and four nuclei (eight chromosomes) in the egg cell. When such eggs are in metaphase, all the chromosomes have undergone diminution. In a few late prophase, however, all the chromosomes appear to be undiminished.

It seems clear that Boveri's explanation<sup>2</sup> of chromosome diminution, although valid in its reliance on cytoplasmic rather than nuclear control, is inadequate for the observations reported here. The mere presence of an inert material which either prevents (or causes) diminution can not account for the fact that it may take place in eggs when cleavage has been suppressed, although nuclear divisions and, presumably, other changes have occurred. It is these other changes which take place independently of cleavage but ordinarily correlated with it, to which attention must be turned in seeking an

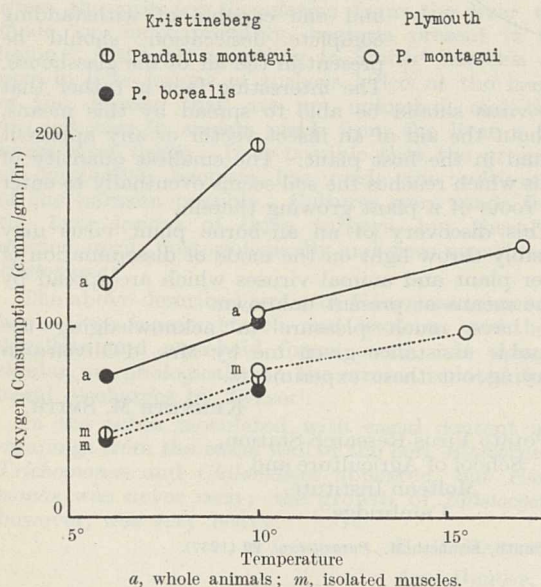


Fig. 1.

Fig. 1 shows that *Pandalus borealis* from the cold water at Kristineberg<sup>1</sup> and *P. montagui* from Plymouth fully bear out the hypothesis. The oxygen consumption values for the whole animals fall on a single curve rising with temperature, and those for the muscles fall on another single curve parallel to the first. At every temperature the excess oxygen consumption of the whole animals over that of the muscles is the same.

explanation; therefore, the following hypothesis is suggested: Chromatin diminution in *Ascaris megalocephala* is caused by the formation of 'diminisher', *D*, during the early cleavages of the egg. This 'diminisher' is produced from a cytoplasmic substance, *S*, which is more concentrated at the pole (which normally gives rise to somatic cells only), than at the anti-pole (which normally gives rise to both somatic and germinal cells). *S* changes to *D* slowly, but, before the concentration of *D* can become critical, the first cleavage usually occurs, thus segregating the greater portion of *S*→*D* into the polar cell (*AB*) which is destined to undergo chromatin diminution when it divides or at the next following division of its two daughter cells (*A* and *B*). The smaller portion of *S*→*D* is passed into the anti-polar cell (*P*<sub>1</sub>), but, before the concentration of *D* becomes critical, the cell divides (into *P*<sub>2</sub> and *EMSt*), most of *S*→*D* going into one of the daughter cells (*EMSt*) which undergoes chromatin diminution, the other (*P*<sub>2</sub>) remaining undiminished.

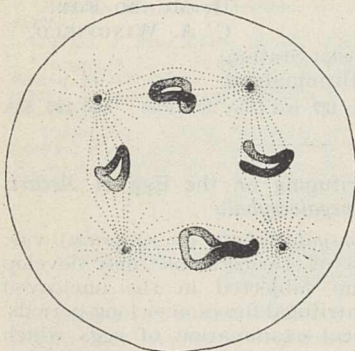


Fig. 1.

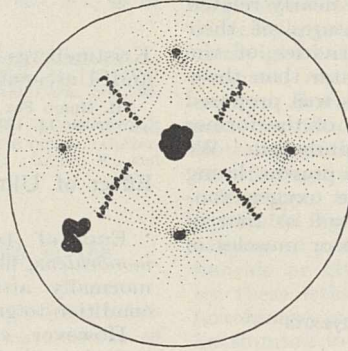


Fig. 2.

This differential partition of *S*→*D* is repeated until there is none, or at any rate, not enough, left in the primordial germ cell to cause chromatin diminution. Neither *S* nor *D* are to be identified as any visible inclusion in the cytoplasm. The process *S*→*D* is not disturbed by centrifuging, so that when the first cleavage has been suppressed by centrifuging, the concentration of *D* may become sufficient to cause diminution before the multipolar cleavage segregates the greater part of *S*→*D* into one (or more) cells. Even when such cleavage does take place, diminution usually follows in the four (or, less frequently, three) cells which result. If both the first and second cleavage are suppressed, diminution usually takes place in the uncleaved egg.

Diminution, then, is an example of chemo-differentiation; the rate of formation of the 'diminisher' depends upon the different concentration of the material producing it, in various regions of the cell. During cleavage, these regions are isolated by cell division, so that the process may occur in one daughter cell and not in the other.

This investigation was aided by grant from the Rockefeller Foundation for research in cellular biology.

R. L. KING.  
H. W. BEAMS.

Zoological Laboratory,  
State University of Iowa.  
Jan. 6.

<sup>1</sup> Beams, H. W., and King, R. L., "Survival of *Ascaris* Eggs after Centrifuging", *Science*, **84**, 138 (1936).

<sup>2</sup> Boveri, Th., "Die Potenzen der *Ascaris*-Blastomeren", *Festschr. R. Hertwig*, **3**, 131 (1910).

### An Air-borne Plant Virus

IN a recent publication<sup>1</sup>, an account is given of an unusual plant virus which is found in the roots of normal-looking plants of different species growing in the insect-proof glasshouse under conditions usually considered proof against virus infection. It is shown that this virus is water-borne to the soil, whence it reaches the roots of the plants.

The fact that the virus could still be detected in the roots of tobacco plants growing in autoclaved soil and watered only with boiled tap water, suggested that there was an alternative method of spread for the virus. Experiments were therefore planned to find out if the virus was also air-borne. Three types of suction apparatus were employed to test the air of the glasshouse. The first two were unsatisfactory, and gave negative results. The third type, designed by Mr. J. P. Doncaster, consisted of an electric pump connected by rubber tubing to six gas-washing bottles placed in different parts of the glasshouse. Each bottle contained a pad of moist cotton

wool through which the air of the glasshouse was drawn. The cotton wool was tested for virus at 48-hour intervals by rubbing it on to the leaves of the French bean (*Phaseolus vulgaris*), which is an extremely sensitive test plant for the virus. This method was more successful, and, in three separate experiments, the virus was isolated from the cotton wool pads.

It is not perhaps surprising that such a minute virus (average particle diameter, 20–30 millimicrons), and one capable of withstanding complete desiccation, should be present in the air of the glasshouse.

The interesting fact is rather that the virus should be able to spread by this means, without the aid of an insect vector or any apparent wound in the host plant. The smallest quantity of virus which reaches the soil seems eventually to enter the roots of a plant growing therein.

This discovery of an air-borne plant virus may possibly throw light on the mode of dissemination of other plant and animal viruses which are spread by some means at present unknown.

I have much pleasure in acknowledging the valuable assistance given me by Mrs. d'Oliveira in carrying out these experiments.

KENNETH M. SMITH.

Potato Virus Research Station,  
School of Agriculture and  
Molteno Institute,  
Cambridge.

<sup>1</sup> Smith, Kenneth M., *Parasitology*, **29** (1937).

### Cultivation of *Histomonas meleagridis* from the Liver Lesions of a Hen

'BLACKHEAD' (entero-hepatitis), a widespread and generally fatal disease of turkeys, was attributed to a protozoon, *Amoeba meleagridis*, by Theobald Smith<sup>1</sup>. Later, Tyzzer confirmed its presence in caecal lesions and renamed it *Histomonas* (gen. nov.) *meleagridis* Smith<sup>2</sup>. Although there is no difficulty in infecting young chickens experimentally with *H. meleagridis* (Tyzzer<sup>3</sup>) the disease produced is not severe, and the

chickens soon recover clinically, though they may remain 'carriers', passing Protozoa in their faeces, for long periods. Theobald Smith<sup>4</sup> saw *Amoeba* (= *Histomonas*) *meleagridis* in liver sections from diseased fowls, and Tyzzer<sup>5</sup> found similar lesions in a two-year-old hen. Although Drbohlav<sup>6</sup> and afterwards Tyzzer<sup>7</sup> cultivated *Histomonas meleagridis* from the caecal discharges of experimentally infected chickens, all attempts to cultivate the parasite from diseased tissues from either turkeys or chickens failed (Tyzzer<sup>7</sup>).

Hitherto, the disease had been considered rare in mature fowls, but during the past year it appears to have occurred in several localities in England amongst laying stock, and in chickens on the farm belonging to one of us (H. P. B.). On December 3, 1936, we received a Rhode Island Red hen from a farm in Shropshire. Examination revealed focal necrosis of the liver and caecal lesions which were macroscopically and microscopically similar to those occurring in turkeys suffering from 'blackhead'. Material taken with aseptic precautions from the necrotic areas in the hen's liver was inoculated into a tube containing an inspissated whole-egg slope covered with inactivated horse-serum diluted 1:8 in Ringer's solution to which a little solid, sterile rice starch had been added. Other similar tubes were inoculated with caecal contents and scrapings. On incubation at 37° C., *Histomonas* appeared within 24 hours in the tube inoculated from the liver lesions. This strain of *Histomonas* from the liver is now in its twelfth sub-culture and is growing excellently on the above-described medium and on other media. In addition to *Histomonas*, the cultures contain a mixture of bacteria. These may be contaminants introduced when the primary inoculation from the liver was made, or, more probably, bacteria present in the lesion. Although according to Smith<sup>4</sup> bacteria are rare in liver lesions of turkeys killed at the height of the disease, they are not unknown, and they are not rare in smears made from the liver a few hours after death. It is possible that the presence of compatible bacteria has made the cultivation of the parasite possible. Cultures were made from the liver lesions of three turkeys, but these remained sterile bacteriologically and were negative for *Histomonas*.

The above-described strain of *Histomonas* from the hen's liver ingests starch and bacteria, and both flagellate and amoeboid forms occur. It appears similar morphologically to the strains isolated from caecal discharges by Tyzzer<sup>7</sup>.

In the tubes inoculated with caecal content and scrapings from the caecal wall of the hen, *Blastocystis*, *Trichomonas* and *Chilomastix* appeared, but *Histomonas* was never seen; the growth of *Blastocystis*, however, was very heavy.

H. P. BAYON.

ANN BISHOP.

Molteno Institute,  
University,  
Cambridge.  
Feb. 2.

## Effects of Colchicin and of *Viscum album* Preparations upon Germination of Seeds and Growth of Seedlings

THE investigations of A. P. Dustin and his school<sup>1-5</sup> have revealed an elective and extremely powerful karyokinetic action of the alkaloid colchicin upon the cells of certain specific organs and, in general, in all the germinative zones of animals, as well as upon the malignant tumours of the same. Dustin has also shown that this karyokinetic impetus is followed by an equally energetic karyoclastic effect upon the same tissues, and that this effect is specially marked in tumour cells, which are ultimately caused to collapse to a great extent under the influence of this alkaloid.

In a previous communication<sup>6</sup>, I have given an account of the effects of several *Viscum album* preparations—containing as one of their active principles the alkaloid viscalbin (Leprince)—on plant tumours of the crown gall type (phyto-carcinomata) which regressed and collapsed to a very marked extent when treated with these preparations.

In the preliminary experiments outlined in this note, I have investigated, at the suggestion of Prof. A. P. Dustin, the extent to which a parallelism can be found between the reactions observed in animals treated with colchicin and between the responses of plants treated with the same substance. I have also tried to ascertain whether these responses can be stimulated or inhibited by simultaneous applications of different preparations of *Viscum* according to their content of the above mentioned alkaloid.

Pure line Wilhelmina wheat, kindly given me by W. H. Parker of Cambridge, was germinated on filter paper in Petri dishes. 3-5 ml. of aqueous solutions of colchicin (Merck) or a dialysate of *Viscum* (Zyma)—free from the alkaloid viscalbin—or the pressed sap of *Viscum*, rich in viscalbin (kindly prepared and preserved in an atmosphere of carbon dioxide according to my prescription, by Zyma, Ltd., Nyon), or a combination of one or the other of these *Viscum* preparations with colchicin were added daily to the Petri dishes. The technique used was otherwise the same as that described in previous communications<sup>7,8</sup>. No tables and measurements can be given here, but the following remarks are based both upon these and the general behaviour of the seedlings throughout the experimental period.

The experiments have shown that, in the concentrations used, colchicin exerts at the beginning of its application a definite stimulating effect on the rate of development of the roots and root-hairs. This effect is followed in 5-8 days by a very marked depression of the growth-rate of the roots, and in another day or two their growth is completely arrested. The growth-inhibiting influence of colchicin on the shoots begins even earlier. Synergetically, a dialysate of *Viscum* (containing no alkaloid) added to colchicin had, from the beginning to the end of the experiment, a more powerful growth-inhibiting action than the same quantities of either dialysed *Viscum* or colchicin, being applied separately. The simultaneous administration of colchicin and of the pressed sap of *Viscum* (containing the alkaloid viscalbin) had no such effects, and actually increased, in one of the concentrations used, the total weight of the shoots as compared with that of the seedlings treated with either *Viscum* sap or colchicin alone. Similar

<sup>1</sup> Smith, T., *Bull. U.S. Dep. Agric.*, 8, 7 (1895).

<sup>2</sup> Tyzzer, E. E., *J. Parasit.*, 6, 124 (1920).

<sup>3</sup> Tyzzer, E. E., *J. Med. Res.*, 44, 676 (1924).

<sup>4</sup> Smith, T., *J. Med. Res.*, 33, 243 (1915).

<sup>5</sup> Tyzzer, E. E., *J. Med. Res.*, 40, 1 (1919).

<sup>6</sup> Drbohlav, J. J., *J. Med. Res.*, 44, 677 (1924).

<sup>7</sup> Tyzzer, E. E., *Proc. Amer. Acad. Arts and Sci.*, 69, 191 (1934).

observations were made as regards the relative growth-rate of the roots.

The most specific effects of colchicin appear to consist, however, in (1) a bulbous hypertrophy of the root-cap, indicating an enhanced activity of the caliptrogen; and (2) a bulbous hypertrophy of the coleoptile and the thickening of its walls, accompanying the lignification of certain parenchymatous elements. The resistance thus presented by the coleoptile to the elongation and breaking through of the shoot also appears to cause the mechanical compression of this last, resulting in a bulbous deformation of the bases of the shoots.

These findings are further supported by the cytological examination of the regions affected, and appear to give, in the present state of the investigations, evidence of a parallelism between certain specific responses of plants and of animals when treated with colchicin.

The final interpretation of these observations must depend, however, upon further work.

LÁSZLÓ HAVAS.

Institute of Pathological Anatomy,  
University, Brussels.  
Feb. 2.

<sup>1</sup> Dustin, A. P., *C.r. sé. Ier Congrès lutte sci. contre Cancer*, 183 (Madrid 1933).

<sup>2</sup> Dustin, A. P., *Bull Acad. roy. méd. de Belgique*, 14, 487-502 (juillet 1934).

<sup>3</sup> Dustin, A. P., *Leeuwenhoek var.*, I Ve conf., Amsterdam (Juin 1935).

<sup>4</sup> Dustin, A. P., *Arch. port. sci. biol.*, 5, 38-43 (1936).

<sup>5</sup> Lits, F. J., *C.r. sé. Soc. Biol. belge*, 118, 393 (22 décembre 1934).

<sup>6</sup> Havas, L., *C.r. sé. Iie Congrès lutte sci. contre Cancer* (Bruxelles 1936).

<sup>7</sup> Havas, L., *NATURE*, 136, 435 (Sept. 14, 1935).

<sup>8</sup> Havas, L., and Gál, I., *NATURE*, 138, 586 (Oct. 3, 1936).

### Gamma Ray Excitation by Fast Neutrons

THE emission of gamma rays from substances traversed by fast neutrons was at first studied by Lea<sup>1</sup>, using neutrons produced by bombarding beryllium with alpha rays. The subject was also studied by Kikuchi, Aoki and Husimi<sup>2</sup>, using homo-

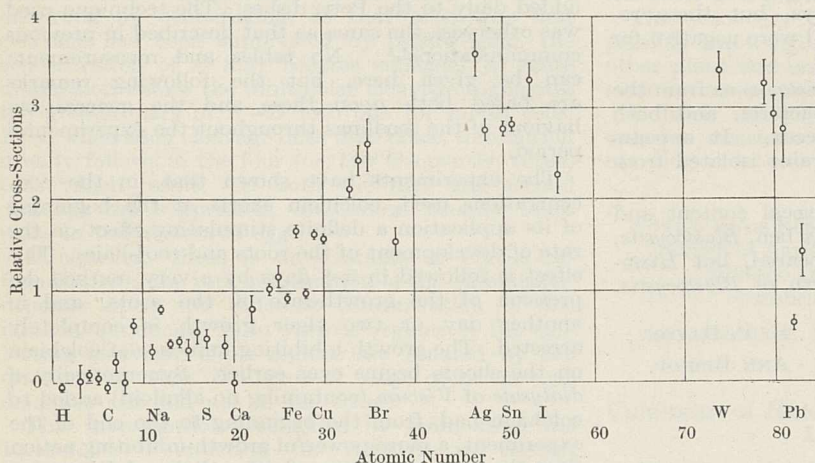


Fig. 1.

geneous neutrons from the deuteron-deuteron reaction. The same experiment has been repeated more accurately and using more elements than before, the result being shown in Fig. 1. [On account of the difficulty of finding space below the atomic number axis

for the symbols of all the elements examined, a few only have been inserted as a guide.—Ed. *NATURE*.]

The experimental procedure was the same as before. In the present case, however, any substance near the neutron source was removed as far away as possible to suppress the secondary gamma rays which constitute a part of the background radiation to the counter, and also to avoid the possible change of energy spectrum of initially homogeneous neutrons.

In Fig. 1, the ordinate indicates relative atomic cross-sections, which were determined by the intensities of gamma rays from radiators so thin that the absorptions of neutrons and the emitted gamma rays were negligible. The cross-sections have not been corrected for the efficiency variation of the counter with the energy of gamma rays. The wall of the counter was made of aluminium, 3 mm. in thickness. In all cases, no gamma ray was observed after the neutron irradiation ceased.

Fig. 1 shows that the sudden jump of the cross-sections at  $Z$  (atomic number) = 9 is conspicuous, but discontinuities near  $Z = 17$  suggested formerly can scarcely be recognized. It is quite interesting to note that the points are distributed roughly on a smooth curve which ascends in the region of lower atomic number and becomes horizontal at  $Z = 50$ , and probably falls again above  $Z = 80$  (that is, in the region of radioactive elements). The deviations of points from this smooth curve are far in excess of the experimental errors.

These gamma-rays may be emitted by nuclear excitation by the 2.4 m.e.v. neutrons used, although we have no positive proof of this. Scarcity of secondary electrons with energy more than 2.4 m.e.v. is a strong support for this hypothesis.

The dependence of the cross-sections on the atomic number shown in Fig. 1 is different from that of absorption scattering cross-sections of fast neutrons obtained by Dunning<sup>3</sup>. From this fact we know that the emission of gamma rays is only part of the result of absorption and scattering of fast neutrons by nuclei. There may exist many other types of interaction; for example, disintegration of nuclei or the emission of  $\beta$ -rays from substances traversed by neutrons, which was reported by Kikuchi, Aoki and Husimi<sup>4</sup>. Absorption cross-sections of fast neutrons were determined by Collie and Griffiths<sup>5</sup>, who detected neutrons by induced radioactivities by fast neutrons, and they obtained a constant value for several elements including copper, lead, etc. It is probable that these absorptions result from gamma ray emission, but the gamma ray excitation cross-sections in Fig. 1 are not constant for these elements. However, it must be taken into account that the energies of the neutrons are different in this case and from that of Collie and Griffiths.

It is natural to relate the emission of gamma rays to the production of slow neutrons by heavy nuclei. Collie and Griffiths observed that lead produces about the same number of slow neutrons as copper when reduced to the same number of atoms, but the

cross-section for gamma ray excitation of lead is distinctly smaller than that of copper. The energy determination of emitted gamma rays is very interesting in this respect.

A detailed report of this work will be published shortly in *Proc. Phys. Math. Soc. Jap.*

HIROO AOKI.

Physical Institute,  
Osaka Imperial University,  
Osaka.  
Jan. 1.

<sup>1</sup> *Proc. Roy. Soc., A*, **150**, 637 (1935).

<sup>2</sup> *NATURE*, **137**, 398 (1936), and *Proc. Phys. Math. Soc. Jap.*, **18**, 115 (1936).

<sup>3</sup> *Phys. Rev.*, **45**, 586 (1934).

<sup>4</sup> *NATURE*, **138**, 841 (1936).

<sup>5</sup> *Proc. Roy. Soc., A*, **155**, 434 (1936).

### Mechanical Tracer for Electron Trajectories

THE paths of electrons in vacuum devices have been in recent years objects of intensive study. The problem involves in general the solution of a partial differential equation for the field, and if the field is known, the solution of an ordinary differential equation for the motion of the electron. The first problem is usually solved experimentally, by constructing a large-scale model of the device, which is immersed in an electrolyte, and exploring the field with a probe. The second step is either to construct the electron paths by some graphical method in a map of the potential lines, or to introduce the data derived from probe measurements into certain approximative differential equations, as developed by H. Busch, W. Glaser, O. Scherzer *et al.*

An apparatus has been designed which makes it possible to trace the electron paths without mapping the potential field, and without calculation. Its

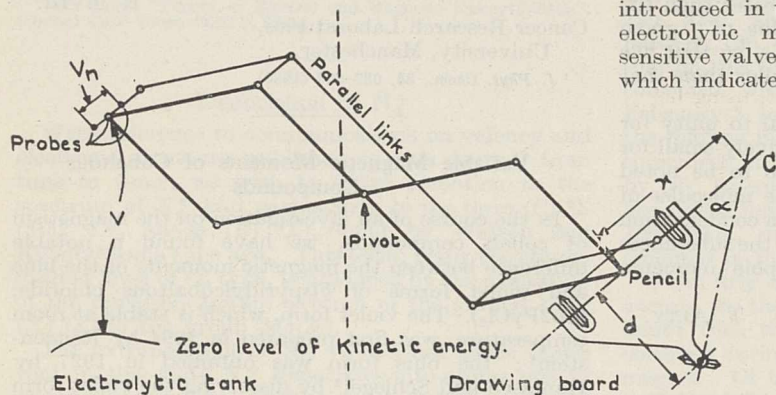


Fig. 1.

principle, in the case of space-charge free electrostatic fields and plane electron paths, is as follows:

The curvature radius of the electron path is  $r = 2V/E_n$ , where  $V$  is the potential drop in which the electron has acquired its energy and  $E_n$  the field intensity normal to the path. In the electrolytic model the electron is represented by a probe and  $V$  is its potential with respect to the zero level of electron energy.  $E_n$  is measured by side probes, placed closely at either side of the main probe, at equal distances. The connecting line of these probes is kept always perpendicular to the path by the mechanism shown in Fig. 1.

The pencil tracing the electron path on a drawing board is carried by a trolley with three sharp-edged wheels. The pencil is connected with the main probe by means of a pantograph, and the trolley is linked with the side probes in such a way that their connecting line is always parallel to the leading wheels of the trolley, and therefore perpendicular to the path.

The trolley is steered by its third wheel, which can turn around a vertical axis. If the steering angle is  $\alpha$ , the curvature radius of the pencil trace is  $r = d \cot \alpha$ . The pencil draws the true electron path if  $\tan \alpha = k \cdot V_n/V$ , where  $V_n$  is the voltage between the side probes and  $k$  is a constant of the device. This steering angle is determined without any calculation by a special bridge, shown in Fig. 2:

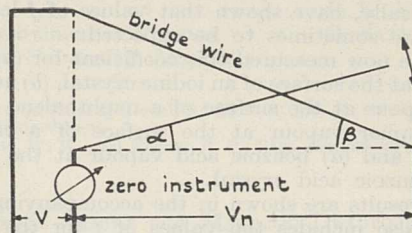


Fig. 2.

This bridge is set to zero if  $\tan \alpha = \tan \beta \cdot V_n/V$ . If  $\tan \beta$  is made equal to  $k$ , the steering angle is found by balancing  $V$  on a second bridge and simultaneously balancing the 'tangent bridge'. This angle is transmitted to the steering wheel automatically by means of a differential gear and parallel links. The trolley is moved on in small steps, keeping the bridges in balance all the time, and the pencil traces the path of the electron (or of any other charged particle).

In order to obtain the high accuracy required in electron-optical work, an improvement has been introduced in the bridge method as hitherto used in electrolytic model experiments. An extremely sensitive valve-wattmeter is used as zero instrument, which indicates zero, not if the slider of the bridge which indicates zero, not if the slider of the bridge has the same potential as the probe (a condition which cannot be fulfilled in general), but if the voltage vector between them is perpendicular to a fixed voltage chosen as 'base'. Thus one time-component of the potential vectors is sorted out. This has the advantage that it not only reduces the random error to negligible proportions, but also eliminates at the same time the systematic error, introduced by the polarization capacities at the electrodes.

The first apparatus of this particular kind has recently been completed in the Research Laboratories of the British Thomson-Houston Co. Ltd, Rugby. I wish to acknowledge my grateful thanks to my colleagues in the Research Laboratory, and to Mr. H. Warren, chief of the Laboratory, and the directors of the B.T.H. Co. Ltd. for permission to publish this note.

D. GABOR.

Research Laboratory,  
British Thomson-Houston Co. Ltd.,  
Rugby.  
Jan. 16.

### Condensation Coefficients of Various Substances

THE ratio of the number of gas molecules *condensing* on a surface per second to the total number *incident* on the surface may be defined as the 'condensation coefficient' ( $f$ ) of the gas at the surface. It has usually been assumed that this coefficient has the value unity; in other words, that every gas molecule striking the solid surface remains attached to it for some time before returning to the gas phase.

Some years ago, however, it was shown<sup>1</sup> that the condensation coefficient of water vapour at a liquid water surface and that of ethyl alcohol vapour at the corresponding liquid surface were considerably less than unity ( $f = 0.036$  for water), and recently Lennard-Jones and Devonshire<sup>2</sup>, having examined the problem of condensation at a crystal surface theoretically, have shown that values of  $f$  less than unity are sometimes to be expected.

I have now measured this coefficient for (a) iodine vapour at the surface of an iodine crystal, (b) naphthalene vapour at the surface of a naphthalene crystal, (c) camphor vapour at the surface of a camphor crystal, and (d) benzoic acid vapour at the surface of a benzoic acid crystal.

The results are shown in the accompanying table, which also includes the values of  $f$  for the liquids examined earlier and that for mercury as determined by Knudsen<sup>3</sup>.

Substance	Condensation coefficient
Iodine .. .. .	1.0
Naphthalene .. .. .	1.0
Benzene .. .. .	1.0
Carbon tetrachloride .. .. .	1.0
Mercury .. .. .	1.0
Synthetic camphor .. .. .	0.17
Benzoic acid .. .. .	0.29
Water .. .. .	0.036
Ethyl alcohol .. .. .	small

Owing to the powdery surface of the solid benzoic acid, the true surface area must be greater than the apparent area. In obtaining the value of  $f$  given above, no allowance was made for this, so that the true value of  $f$  must therefore be smaller than that given.

It will be seen that, while  $f$  is equal to unity for iodine and naphthalene, it is comparatively small for camphor and benzoic acid. It is also to be noted that all those substances examined the molecules of which have a zero dipole moment have a condensation coefficient of unity; on the other hand, the substances the molecules of which have large dipole moments have small values of the coefficient  $f$ .

T. ALTY.

University, Glasgow.

Jan. 28.

<sup>1</sup> Alty, *Proc. Roy. Soc., A*, **131**, 553 (1931); *A*, **149**, 104 (1935).

<sup>2</sup> Lennard-Jones and Devonshire, *Proc. Roy. Soc., A*, **156**, 6 (1936).

<sup>3</sup> Knudsen, *Ann. Phys.*, **47**, 697 (1915).

### Molecular Distillation of Petroleum Lubricating Oils

In some preliminary distillations of lubricating oils carried out in this laboratory, we have encountered results quite contrary to those anticipated, and as we believe them to be unlike any results hitherto reported, we deem them worthy of notice, even at this early stage of our investigations.

So far, the distillation of two oils, a Scottish shale oil and a Persian oil, using a specially designed

molecular still, has been carried out. This still is based on the principles set forth by Hickman and Sanford<sup>1</sup>. The temperature control, and to some extent the pressure regulation, were not very constant (the temperature varied  $\pm 3^\circ \text{C.}$ ), but even so the results are consistent. The most striking result, allowing for the lack of good temperature control, to our minds, is the inversion that has taken place in the change in the physical properties as we go up the temperature scale. Thus, instead of the first fractions showing low refractive indices and densities, they actually gave figures higher than those of the original oil, with gradually descending values from fraction 4 as the temperature is raised. The accompanying table makes this clear.

MOLECULAR DISTILLATION OF SHALE OIL No. 55  
(ALL CHARACTERISTICS AT  $25^\circ$ )

Fraction	Density	Refractive Index	Refractivity (centipoises)	Viscosity (centipoises)	Temperature (approx.)
Original oil	0.8935	1.5039	0.5640	51.86	
1	0.8961	1.5092	0.5682		40
4	0.9070	1.5151	0.5679	33.29	59
6	0.9018	1.5109	0.5665		60
10	0.8929	1.5038	0.5642	50.21	65
15	0.8805	1.4950	0.5622	66.25	95
Residue	0.8996	1.5064	0.5629	228.6	

We, ourselves, are specially interested in the carcinogenicity of these molecular distillates as compared with the products obtained by use of solvents. For example, all samples of petroleum oils we have treated with alcohol have provided residues of lower carcinogenicity than the original oil, but while index and density were always lower, viscosity was sometimes higher than that of the original oil. All these experiments have a bearing on the important question of the interrelation of index and viscosity to activity on injection, and thereby carcinogenicity when applied to the skin.

R. LYTH.

Cancer Research Laboratories,  
University, Manchester.

<sup>1</sup> *J. Phys. Chem.*, **34**, 637-653 (1930).

### Variable Magnetic Moments of Cobaltous Compounds

In the course of an investigation on the magnetism of cobalt compounds, we have found a notable difference between the magnetic moments of the blue and violet forms of bispyridylcobaltous chloride, ( $\text{Co}_2\text{PyCl}_2$ ). The violet form, which is stable at room temperature, was first prepared in 1894 by Reitzenstein<sup>1</sup>; the blue form was obtained in 1927 by Hantzsch and Schlegel<sup>2</sup> by dissolving the violet form in chloroform and precipitating the substance by dilution with ligroin. The blue form can also be prepared by heating the stable form to  $120^\circ$ ; it is unstable at room temperature and reverts to the violet form in a few days. Much work has been done on the absorption spectra, molecular weight, and conductivity of these substances<sup>3</sup>.

Fahlenbrach<sup>4</sup> measured the susceptibility of solutions of cobaltous chloride ( $\text{CoCl}_2$ ) in pyridine; below  $-20^\circ$  the  $1/\chi, T$  curves were linear and gave  $\mu_{\text{eff.}} = 5.0$  Bohr magnetons over a range of dilutions. These red solutions probably contain  $[\text{Co}_6\text{Py}]^{++}$ . From  $-20^\circ$  to  $+35^\circ$  the solutions were violet and the  $1/\chi, T$  curve was not linear. Above  $35^\circ$  the solution was blue but the slope of the  $1/\chi, T$  curve varied with

dilution, and it was clear that a change in the magnetic moment of the carrier was taking place.

By using the pure solid compounds with two molecules of pyridine, we have found a large difference in moment between the two isomerides. The stable violet form gives at room temperature  $\mu_{\text{eff.}} = 5.34$ . The blue form, prepared by heating to  $120^\circ$  for a few hours and cooling rapidly with solid carbon dioxide gave in successive experiments  $\mu_{\text{eff.}} = 4.62, 4.58$  when measured at  $20^\circ$ . The true value may be slightly lower since conversion to the violet form soon caused a marked increase in moment, which rose to  $5.3$  in a few days.

The magnetic moment of most of the elements of the first transition series is close to that predicted for electron spin only<sup>5,6</sup>. Bivalent cobalt compounds are an exception to this rule and usually possess moments greater than that predicted for an electron spin of  $3/2$ , namely,  $\mu_{\text{eff.}} = 3.87$ . Some orbital component seems to be conserved and the degree of conservation may depend upon the symmetry of the environment of the magnetic atom<sup>7</sup>. If the violet form has the structure  $[\text{Co}_4\text{Py}]_2^+(\text{CoCl})_4^-$  then the cobalt atoms have a more symmetrical environment than in the unionized structure  $[\text{Co}_2\text{PyCl}_2]$ , which may represent the blue form. This interpretation leads, however, to difficulties in connexion with the magnetism of other cobalt complexes which will be described elsewhere.

E. D. P. BARKWORTH.  
S. SUGDEN.

Birkbeck College,  
London, E.C.4.

<sup>1</sup> *Lieb. Ann.*, **282**, 267 (1894).

<sup>2</sup> *Z. anorg. Chem.*, **159**, 273 (1927).

<sup>3</sup> Rohde and Voigt, *Z. phys. Chem.*, **B**, **15**, 353 (1932); Werner and Schmojlow, *Z. anorg. Chem.*, **15**, 23 (1927); Brode, *J. Amer. Chem. Soc.*, **53**, 2457 (1931).

<sup>4</sup> *Ann. Physik.*, **13**, 265 (1932).

<sup>5</sup> Bose, *Z. Phys.*, **43**, 864 (1927).

<sup>6</sup> Stoner, *Phil. Mag.*, **8**, 250 (1929).

<sup>7</sup> van Vleck, "Theory of Electric and Magnetic Susceptibilities". (Oxford Univ. Press, 1932, p. 287).

### Dissociation of $\text{N}_2^+$

WITH reference to communications on valency and electronic structure published in this journal from time to time<sup>1</sup>, we wish to direct attention to the spectrum of  $\text{N}_2^+$  and particularly to the term  $(C) \ ^2\Sigma$  ( $3.52$  e.v. above  $(B) \ ^2\Sigma$ ) found by Watson and Koontz<sup>2</sup> some time ago. This term, being the second excited level of  $^2\Sigma$  type, is produced by the excitation of the unpaired  $3s\sigma(2p)$  electron of the ground state  $(X) \ ^2\Sigma$ , to the group  $3d\sigma(3s)$ .

The extrapolation of the vibrational levels shows that in this state  $\text{N}_2^+$  dissociates into atoms one of which is excited by  $11.28$  e.v. (or  $10.20$  e.v. if the cubic term of the equation is employed). This value agrees perfectly well with the energy of excitation of nitrogen from its ground state  $2s^2 2p^3 \ ^4S$  to the level  $2s^2 2p^2 3s \ ^4P$  ( $=10.29$  e.v.) which is indeed the lowest term in which N possesses a  $3s$  electron. The energy of dissociation or formation of the molecule in this state is about 50 per cent bigger than that for the ground level. This shows that a more stable chemical linkage is produced in  $\text{N}_2^+$  if the unpaired electron is removed to the next shell by excitation, the conditions being very similar to those in NO, discussed earlier<sup>1</sup>. There is, however, one significant difference. In NO the unpaired electron is in a promoted, or antibonding group. In  $\text{N}_2^+$  the odd electron is a non-promoted or bonding electron.

This constitutes the first example which unambiguously shows that a single unpaired electron does not act as bonding but weakens the linkage, even if it is in a bonding orbital. Further, the large increase in dissociation energy as the molecule is excited from  $(X) \ ^2\Sigma$  to  $(C) \ ^2\Sigma$  state, directly contradicts the general identification of non-promoted with bonding and promoted with antibonding electrons. This evidence and other experimental results, which are mentioned earlier, are to our mind incompatible with the latter hypothesis.

A more detailed discussion will be given in connexion with considerations on the applicability of the Birge-Sponer method of vibrational extrapolation in a forthcoming paper, in the *Proceedings of the Indian Academy of Science* (Bangalore).

R. K. ASUNDI.  
R. SAMUEL.

Department of Physics,  
Muslim University, Aligarh.  
Jan. 25.

<sup>1</sup> Hunter, R. F., and Samuel, R., *NATURE*, **138**, 411 (1936), and literature mentioned there.

<sup>2</sup> Watson, W. W., and Koontz, G. P., *Phys. Rev.*, **46**, 32 (1934).

### Recent Auroræ and Magnetic Disturbances

WITH reference to the displays of aurora on January 7 and February 3, reported in *NATURE* of February 13 and 20, pp. 277 and 318, the following further details may be of interest. The aurora of January 7 was noted by an observer in the vicinity of Preston, who reported seeing it between 19h. and 19½h. U.T. On this occasion, the magnetic records of Stonyhurst Observatory show a moderate disturbance between 18h. and midnight, the most notable movements being a fall of  $27'$  in westerly declination between 19h. 15m. and 19h. 32m., followed by a sharp rise of  $28'$  between 19h. 32m. and 19h. 42m., whilst horizontal force rose by  $140\gamma$  between 19h. 22m. and 19h. 34m. and then fell by  $180\gamma$  between 19h. 36m. and 19h. 43m. It may be noted that on this occasion the minimum value of  $D$  almost coincided with the maximum value of  $H$ . On February 3, however, these conditions were reversed, the minima in  $D$  and  $H$  being almost, but not quite, coincident in time. On this occasion, declination fell by  $70'$  between 18h. 58m. and 19h. 12m., whilst horizontal force fell by  $225\gamma$  between 18h. 56m. and 19h. 09m., each element rising by corresponding amounts in the next ten minutes.

From fifty accounts received from observers of the aurora on the latter occasion, there can be little doubt that the most brilliant part of the display occurred during the easterly swing of the declination magnet. Of the fifty observers, eight first noted it between 18h. 40m. and 18h. 45m., and seven gave the end as 19h. 25m. or 19h. 30m., whilst no fewer than twenty-five reported first seeing it between 18h. 55m. and 19h., and twenty-nine gave the end as 19h. 10m. or 19h. 15m., the rest giving intermediate times for the first and last observations. It seems clear that whilst some observers noted the fainter glows near the beginning and end, the majority saw only the more vivid portions of the display. Two observers first noted it at 18h. 57m., two others note an increase in brilliance at 18h. 58m., one gives the end as 19h. 12m., and one other the duration as from 18h. 57m. to 19h. 12m.

This circumstance, of the display being chiefly during an easterly swing of the declination magnet, seems to apply also to the single local observation of

January 7, and a similar coincidence was noted by me in an observation of the aurora on December 20, 1930. On January 7 last, Mr. Craig in northern Scotland noted conspicuous features between 19h. 30m. and 19h. 45m., and a rapid decrease within a few minutes of the latter time, and it is worthy of note that another sharp fall of 14' in declination was recorded from 19h. 35m. to 19h. 45m., after which minor oscillations occurred.

These observations seem to indicate that the aurora is chiefly manifest whilst a current of negatively charged ions is traversing the upper atmosphere in a direction with a south to north component. If the direction is north-east, the horizontal force would fall concurrently with the declination; whilst if it is north-west, the opposite condition would hold. It would be most useful if observers of the aurora would make careful note of the times when important changes take place, and especially of the time when the phenomena fade out. To get the time of actual commencement of a display is more difficult, as it will in

general have been in progress for some time before being noticed. As the same disturbed region of the sun to which both the recent displays must be attributed will be on the central meridian on February 26, and was at the time of writing (February 20) showing a spot just inside the eastern limb, there is a possibility of a recurrence of the phenomena after the 27-day interval, on March 2, and it will be well worth while to keep a look-out on that evening, and on the preceding and following ones. It may be mentioned that the night sky was observed to be unusually bright with auroral light on February 6, 23h.—24h., February 9, 21h., when clouds prevented further observation, and on February 10, 23h.—24h., on all of which occasions moderate magnetic disturbances were in progress.

J. P. ROWLAND.

Stonyhurst College Observatory,  
Near Blackburn.  
Feb. 20.

### Points from Foregoing Letters

THE presence of traces of calcium, copper and zinc affects considerably the properties of surface films, and Dr. R. J. Myers and Prof. W. D. Harkins consider that the results of many previous experiments reported in the literature (apart from those carried out in strongly acid solutions) are likely to have been vitiated by such contamination. They advise future investigators to use quartz or very heavily paraffined glass troughs, and to make sure that all salts are exceedingly pure.

Further experiments supporting the view that the oxidation of glucose to lactic acid can proceed in the chick embryo without the intermediate mechanism of phosphorylation are adduced by Dr. J. Needham and H. Lehmann. In this reaction, glutathione is necessary. The ordinary phosphorylation mechanism of carbohydrate breakdown operating in muscle through the intermediary of hexosediphosphate, is but of low activity in the chick embryo.

Prof. H. Munro Fox and C. A. Wingfield have measured the oxygen consumption of isolated muscles of prawns from different latitudes to test the hypothesis that the greater oxygen requirements of English compared with arctic invertebrates, each at the temperature of their habitat, is due to a higher non-locomotory metabolism in the former.

Diagrams showing the effect of ultra-centrifuging on the eggs of the horse round-worm are submitted by Dr. R. L. King and Prof. H. W. Beams. The authors connect the diminution observed in the size of the chromosomes with the suppression of cleavage walls, and postulate the presence in the cytoplasm of a 'diminisher' causing diminution of chromatin.

Dr. Kenneth Smith describes the discovery of an air-borne plant virus. This is the first time a plant virus has been shown to spread in this way.

Drs. H. P. Bayon and Ann Bishop report the cultivation *in vitro* of the protozoon *Histomonas melagridis*, from the liver of a diseased chicken showing symptoms similar to those occurring in turkeys suffering from 'blackhead'. This disease is generally attributed to *Histomonas*, but the parasite has not

yet been found in the liver of turkeys nor has it hitherto been successfully cultivated *in vitro*.

Relative cross-sections of 41 elements for gamma ray excitation by 2.4 m.e.v. neutrons have been determined by H. Aoki. The cross-sections plotted against the atomic number are distributed roughly on a smooth curve which rises with atomic number in the region of lower atomic number and probably descends again when the atomic number exceeds eighty.

An apparatus for tracing the paths of electrons in electrostatic fields is described by Dr. D. Gabor. The tracing pencil is moved mechanically on a drawing board, according to indications derived from probe measurements in an electrolytic model. Special precautions are taken to avoid the error introduced by polarization phenomena.

The unusual behaviour of certain petroleum lubricating oils on distillation is described by R. Lyth, who finds that the fractions first distilled have higher densities and refractive indices than the fractions that distil at higher temperatures.

A difference in the magnetic moments of the violet and the blue forms of bispyridylcobaltous chloride has been found by E. D. P. Barksworth and Prof. S. Sugden, who indicate its relation to the symmetry of environment of the magnetic atom.

A discussion of the correlation of the ground level and the second excited level of the molecule  $N_2^+$ , Dr. R. K. Asundi and Prof. R. Samuel state, shows that an unpaired electron weakens a chemical bond even though it is in a non-promoted or bonding orbital. They consider this as a further experimental proof against the identification of non-promoted and bonding electrons, and therefore as an argument in favour of Heitler and London's pair-bond theory of valency.

L. Havas finds that colchicin (the active principle of the autumn crocus) exerts at first a stimulating effect upon the rate of development of the roots and root-hairs of wheat seedlings, followed by inhibition. The effect of mistletoe preparations (with and without the active principle viscalbin), separately and in conjunction with colchicin, are described.



## Research Items

### Control of Secondary Sexual Characters in Birds

MUCH information regarding the secondary sexual characters of birds, their alteration by experimental means and their bearing on the theory of evolution is given in a summary by Dr. Emil Witschi (*Scientia*, 60, No. 11). Many cases of male and female plumage in birds and their alteration by injections or castration are cited. The variety of conditions indicates that male and female plumage types are not necessarily always secondary sexual characters. In some species, plumage types are controlled by genetic factors, in others by hormones from different glands. Gonad hormones appear not to influence seasonal dimorphism. The hypophysis releases small quantities of gonadotropic hormones during sexual inactivity and large quantities in the breeding season. Ovarian hormone inhibits the development of cock plumage, but thyroid hormone appears to do the same. Ornamental plumages render the individual less fit for ordinary survival, but sexual selection cannot be considered the cause of the basic variations from which sex dimorphism has arisen; nor does it throw any light on the complicated hormonal and genetical control mechanisms. It is suggested that the change from hormonal to genic control may have happened through the hormones acting as messengers from soma to germ plasm.

### Primitive Arthropods

THE Cawthron Lecture for 1935, delivered by the late Dr. R. J. Tillyard, has recently been published by the Cawthron Institute, Nelson, New Zealand. The subject of the lecture, "Tracing the Dawn of Life further Backwards", is one of special interest since it embodies the results of recent palaeontological discoveries among the ancient rocks of the Adelaide series. These were the outcome of many years of work by the late Sir T. W. Edgeworth David, and the rocks in question form the Proterozoic series of Australia. They are stratified deposits supposed to have been laid down in Pre-Cambrian times. Among the fossils disclosed, none is more remarkable than those described by David and Tillyard as belonging to the Arthrocephala. This name is given by them to a new Arthropod class which included creatures with four moveable head segments each bearing appendages. The address is accompanied by two plates which represent restorations of these creatures, and are taken from the original memoir lately published by the two writers mentioned.

### Melanophores of the Paradise Fish

THE melanophores of the paradise fish, *Macropodus opercularis*, show two different phases in their reactions to light. The primary phase, according to G. Tomita (*J. Shanghai Sci. Inst.*, Sept. 1936), lasts from their first appearance in the embryo until the eyes have begun to function. In darkness the animals are pale, and in bright light they are dark. The expansion of the melanophores is related to the intensity of the light. The functioning of the eyes is followed by the secondary phase, in which in darkness or in light the fish are pale or dark to correspond

with their surroundings, but the reaction becomes slower with increasing age. The destruction of the eyes in the early larvæ has no effect on the reactions in the primary phase, but later larvæ in the secondary phase when so treated revert to the primary phase. Similar reversion is exhibited also by the newly born young of *Lebistes reticulatus*, *Gambusia affinis* and *Xiphophorus helleri*.

### Pest and Plant

UNDER this title, Messrs. A. G. Bebbington (Empire Cotton Growing Corporation) and W. Allan (Department of Agriculture, Northern Rhodesia) have a very interesting discussion (*Empire Cotton Growing Rev.*, 14, Jan. 1937) of a thesis previously enunciated in the *Review* by Sir Albert Howard that "insects and fungi are not the real causes of plant diseases and only attack unsuitable varieties or crops improperly grown". Against this dictum, Messrs. Bebbington and Allan marshal convincing evidence, from their experience in Northern Rhodesia, of cotton crops in which the damage from bollworm and stainer attack is clearly the greater as the suitability of the locality for the crop increases, as also the care expended in its cultivation. They show also that with one stainer, *Dysdercus fasciatus*, the governing factor in determining its ravages on cotton is the extent of the fruit crop available on its chief host plant in that locality, the tree *Thespesia rogersii*. With the other stainer, *D. supersticiosus*, the story is more complicated, because it has a series of short-lived plants as its hosts and these vary in different regions, so that the incidence of attack varies in the same season from region to region. In all cases, however, both with bollworm and stainer, they produce remarkably strong evidence that, whilst neglected and poor crops of cotton struggle through to harvest with little damage from these pests, side by side with them well-grown plants, instead of yielding good crops, may be nearly ruined by their depredations.

### Dermatophyte Fungi

A CASE of maduromycosis, a fungus disease affecting the legs of human beings, has recently been described from Canada by Drs. R. M. Shaw and J. W. Macgregor (*Canadian Med. Ass. J.*, 33, 23-28; 1935). A clinical history of the disease, which is known as 'madura foot', is given, and the causal fungus has been identified as *Monosporium apiospermum*. Dr. Eleanor S. Dowding also examined the fungus, and her account follows that cited above (*ibid.*, 28-32). The mycelium has the swellings and 'racquet hyphæ' typical of many dermatophytes, and its conidiophores are undifferentiated from the other hyphæ when submerged in the medium. They have a typical erect habit, often with tapering sterigmata, when borne aerially. A species of *Geomyces*, isolated from soil in Alberta, though similar to some of the fungi causing maduromycosis, was found to be non-pathogenic. Dr. Dowding and Dr. H. Orr have also studied the peculiar 'mosaic fungus' which appears in certain tissues parasitized by ringworm fungi. They consider that it is due to the breakdown of the dermatophyte fungus *Trichophyton gypsum*.

### The Sudbury Nickel Irruptive

IN his third paper on the life-history of the great Sudbury intrusion-complex, W. H. Collins describes the evidence bearing on the age relationships of the 'younger granites' to the 'nickel irruptive' (*Trans. Roy. Soc. Canada*, (4), 29; 1936). Dr. Collins and his co-workers have been unable to reach positive conclusions as to the relative ages of the rocks under investigation, though in the case of the Murray granite there are good grounds for the inference that it intruded the norite of the nickel irruptive. The Creighton granite, however, presents many puzzling features. Locally the norite becomes fine-grained against the granite and at one place stringers of a black chilled equivalent of the norite penetrate the granite for five feet. On the other hand, a stringer of granite was found extending from the main granite-mass into the chilled norite; moreover, a series of crooked and branching dykes of porphyritic granite, up to eight feet across where they leave the Creighton granite, has been traced for forty feet into the norite. After a careful discussion of all the possibilities, it is concluded that the apparent contradiction can be accounted for only by the hypothesis that the Creighton granite, though really older than the nickel irruptive, was mobilized by heat and pressure so that it was enabled to flow into cracks developed in the cooling norite. Collins is unable to support this hypothesis by many well-authenticated examples of the same phenomena. Reference may therefore be made to the fact that at the top of the Portrush Sill (near the Giant's Causeway) several occurrences have been found by N. Harris of veins of mobilized hornfelsed Lias which pass downwards into the chilled margin of the Sill from the roof. Other veins in the dolerite of the Sill consist of syntectonic rocks derived from the hornfelsed Lias by metasomatism and transfusion due to the action of magmatic emanations from the dolerite magma (*NATURE*, 138, 984, Dec. 5, 1936).

### Recent Earthquakes at Helena (Montana)

THE destructive shocks of October 18 and 31, 1935, have directed attention to the earthquakes of the sparsely inhabited State of Montana. Mr. F. P. Ulrich has given (*Bull. Seis. Soc. America*, 26, 323; 1936) a brief description of these earthquakes, and has also compiled a list of all known shocks since 1805. Semi-destructive earthquakes occurred on December 10 and 11, 1872, and December 20, 1908, and a destructive earthquake, felt over about 300,000 square miles, on June 27, 1925. After a period of inactivity, the recent series began on October 3, 1935. On October 12, a semi-destructive earthquake was felt at least 200 miles from its centre. It was followed on October 18 and 31 by destructive earthquakes, between which 506 slight shocks were felt, the total number in the series up to the end of March 1936 being 1,794. The two great earthquakes were felt over an area of at least 200,000 square miles. Visible waves were reported by several observers. After each destructive earthquake, the ground at Helena was left crossed by stationary waves, the distance from crest to crest being 24-28 in. and the maximum depth 2-4 in.

### Negative Ion Formation

F. L. ARNOT has found that in mercury vapour negative ions are frequently formed by a positive ion extracting two electrons from any negatively

charged electrode to which they are driven. The resulting negative ion is repelled from the electrode. A new paper by Arnot (*Proc. Roy. Soc., A*, 158, 137) extends this work to hydrogen, nitrogen, oxygen and carbon dioxide. In all these cases negative ions were formed by the new process described above. Only monatomic ions were found in hydrogen and nitrogen, oxygen gave monatomic and diatomic ions, carbon dioxide gave  $\text{CO}_2^-$ ,  $\text{CO}^-$ ,  $\text{O}_2^-$ ,  $\text{O}^-$ , and  $\text{C}^-$ . No negative ions produced by electron attachment could be observed, though this process has in the past been assumed to account for negative ion formation. The probability of conversion of positive to negative ions increases with the incident kinetic energy of the ion incident on the surface. For 180-volt ions it lies between  $10^{-3}$  and  $10^{-5}$ . The energy distribution of the positive ions rebounding as negative ions from a nickel surface has been measured, and the 'accommodation coefficient' defining the fraction of the kinetic energy of the ion lost on collision with the surface has been determined. This coefficient is not single valued, but has a most probable value such that the positive ion after reflection retains a few volts energy. In the case of hydrogen, there are two maximum values of the accommodation coefficient.

### Scattering of Protons by Protons

M. A. TUVE, N. P. Heydenburg and L. R. Hafstad (*Phys. Rev.*, 50, 806) have made a careful study of the scattering of protons in hydrogen gas. The protons were obtained from a high-voltage accelerating tube driven by an electrostatic generator with special arrangements for steadying and measuring the accelerating voltage, which was varied from 600 to 900 kv. The scattered particles were counted by an ionization chamber and linear amplifier. The results are compared with Mott's formula, which assumes the inverse square law of force. At 600 kv. the numbers observed at all angles are about two thirds of the Mott values. At higher voltages, the angular distribution is markedly different from that given by the formula, and the authors were able to assure themselves that the anomaly was real and not instrumental. The field around the nucleus must differ strongly from the inverse square field at distances of the order  $10^{-13}$  cm. A paper by G. Breit, E. U. Condon and R. D. Present (*Phys. Rev.*, 50, 825) investigates the nuclear field by wave mechanical methods, and shows that the observations agree with scattering by a 'potential wall' in which the symmetrical de Broglie wave is distorted in a way corresponding to an attractive force overpowering the Coulomb forces at short distances. The magnitude of the interaction determined agrees with that used by Bethe in the calculation of mass defects of light nuclei. It appears to be identical with the proton-neutron interaction as determined from the scattering and absorption of slow neutrons.

### Absorption Bands in the Spectrum of $\psi$ -Isocyanine Dyes

DR. E. E. JELLEY recently reported (*NATURE*, 138, 1009; 1936) that 1:1' diethyl- $\psi$ -cyanine chloride exhibited a characteristic narrow absorption band and a fluorescence of wave-length very close to that of the absorption band, when it was precipitated from aqueous solution. This he considered to be due to the existence of the substance in a transitory molecular state, intermediate between the dissociated

and crystalline states. Scheibe, Kandler and Ecker (*Naturwiss.*, 25, 75; 1937) find such an absorption band and accompanying fluorescence in aqueous solutions of 1:1' diethyl- $\psi$ -isocyanine chloride of certain concentrations, and believe it to be due to a reversible polymerization of ions of the dye. In support of this view they quote the fact that there is a considerable increase in the viscosity of the solution in the concentration range in which the narrow absorption and fluorescence occur. The polymerization is completely reversed by raising the temperature by about 30°. The phenomenon is much affected by dilution, when viscosity, absorption and fluorescence disappear together. In heavy water the position of the absorption band is the same as in ordinary water. The absorption spectrum of the dye when adsorbed on various surfaces such as glass, quartz, gypsum and mica has been examined, and whilst the narrow band is obtained in all cases, its position is slightly different from that of the band observed with aqueous solutions. The fluorescence is also slightly shifted. Freshly split fluorspar and polystyrol do not adsorb the dye.

#### Secretions of Essential Oils in Plants

In a report presented at the Annual Conference of the International Faculty of Sciences held in London on January 29-30, Prof. J. Politis discusses recent work in his department in the National University, Athens, on the morphology and physiology of certain plant glands. Glands on the leaves and, to a less extent, on the stems of the true artichoke (*Cynara Scolymus*) are responsible for the characteristic bitter taste. The gland originates from a single epidermal cell. The cell divisions taking place during development are described in detail, and the mature gland is figured. The characteristic bitterness of *Jurinea mollis* is found to be due to secretions from glands located on the stem, leaf and under-surface of exterior petals and bracts. Their origin, development and mature structure are also described and figured. Glands have also been found on the cardoon (*Cynara cardunculus*). Reference is made to the physiology of the secretive process, and micro- and macro-chemical tests of the substance secreted are given in detail. No further clues to their chemical nature have so far been obtained, however, but the author considers these bitter substances are essential oils which have been derived from glycosides by enzyme action.

#### Pure Oleic Acid

ALTHOUGH oleic acid is perhaps the most common of the naturally occurring fatty acids, the pure acid is still one of the rare chemicals. Oleic acid always occurs in fats and oils associated with saturated acids and usually with varying amounts of linoleic acid and acids of higher unsaturation. The methods of purification usually start with olive oil and proceed through the purification of the lead and barium soaps, and they are extremely tedious. J. B. Brown and G. Y. Shinowara (*J. Amer. Chem. Soc.*, 59, 6; 1937) show that oleic acid of high purity may be obtained by direct crystallization of the acids of olive oil from acetone. The saturated acids are removed by precipitation at -20°, and the remaining unsaturated acids are crystallized from acetone at -60° four or more times, this treatment being followed by a partial crystallization of the resulting

products from acetone at -35° to remove small amounts of palmitic acid not taken out in the original treatment at -20°. The three specimens obtained, distilled at 15 mm. pressure, all melted at 13.0°; the iodine numbers were 89.63-90.04, and refractive indices  $n_{20}^{20}$  1.4585-1.4586.

#### 'Marmite'

THE Marmite Food Extract Co., Ltd., London, E.C.3, has recently issued a booklet describing the medicinal uses of its well-known preparation, 'Marmite'. This autolysed yeast extract contains in 1 gram about 30 units of vitamin B<sub>1</sub> and is also a good source of vitamin B<sub>2</sub>. Marmite has been found of value in diseases caused by a deficient intake of the B vitamins such as beriberi or pellagra, or when they are incompletely assimilated, as in alcoholic polyneuritis. Insufficiency of vitamin B is also associated with many vague conditions of ill-health, especially those accompanied by gastro-intestinal symptoms: whilst an increased intake is required during pregnancy and lactation. Sufficient evidence has accumulated during the last few years to demonstrate that Marmite possesses anti-anæmic properties. It has been found of value in tropical macrocytic anæmia, in the pernicious anæmia of pregnancy and in the anæmias associated with coeliac disease, sprue, malaria and hookworm infestation. It has also been used successfully in the treatment of certain cases of Addison's pernicious anæmia, probably because it acts as a source of the 'extrinsic' factor: it does not contain a substance of the nature of the liver active principle. The booklet contains a table of the recommended dosage in the different conditions for which Marmite is indicated.

#### Shape of Road Aggregate

IN *Road Research Bulletin* No. 2 (London: H.M. Stationery Office. 6d.) a novel research is described to discover a method of classifying the shape and measuring the dimensions of the material that is placed as a covering on the surface of roads. Rightly or wrongly, surveyors and road engineers have thought that flaky and elongated material is undesirable for road construction. Although there are no records of actual failures that can be directly attributed to flaky material, there is a widespread unanimity of opinion that this material is unsatisfactory. In the British Standard Specifications for rolled asphalt, for example, it is stated that the stones have to be "angular and not flaky", thus hinting that flaky material is inferior. The Department of Scientific and Industrial Research and the Ministry of Transport have co-operated in preparing the bulletin under notice. The shape characteristics of broken stone and other similar materials have been measured and practical applications of the methods devised from the results have been considered. In view of the fact that the degree of flakiness permissible in an aggregate must depend at present on the judgment of the engineer, and since, in practice, deliveries will normally be compared with 'approved samples', no limits governing the maximum percentage of long and flaky material acceptable have been suggested. It is pointed out that flakiness in a crusher-run aggregate commonly varies with size. This fact, which is obviously of importance, is generally overlooked.

## British Industries Fair

THE range of scientific exhibits, or of exhibits having some specific scientific interest, at the Olympia section of the British Industries Fair, was this year wider than ever, and it becomes increasingly difficult, if not indeed impossible, each succeeding year to attempt anything like an adequate survey of the exhibits likely to be of direct interest to scientific workers or to other readers who have an interest in scientific matters. All that can be attempted within the necessarily limited space is to direct attention to certain novel features of this year's exhibits. Perhaps one general observation that may be made is that, as the years go by, one is increasingly aware of how scientific instruments, at one time only of academic or quasi-academic interest, are steadily invading the domain of industry and finding industrial applications not even dreamt of until recently.

The chemical industries were, as usual, well represented, and showed an extraordinarily varied range of products. A large section of the exhibit of Boot's Pure Drug Co. Ltd. was devoted to a biological display, showing in particular a complete X-ray outfit for assaying vitamin D preparations, such as 'Decrose' (glucose with calcium glycerophosphate and vitamin D). They showed, as new products of particular interest to medical men, 'Ovostab' and 'Luteostab', prepared from the active principles of the female reproductive organs. Among their exhibits, British Drug Houses, Ltd., showed, in the hormone group, 'Anahæmin', which is the anti-anæmic principle of liver. It is issued as a solution in ampoules and rubber-capped vials. The Gas Light and Coke Co. exhibited a 'Premix' emulsion, a slow-breaking emulsion of tar, adapted for treating clean-graded road aggregates in an ordinary concrete mixer, producing a material which can be laid cold and gives a non-skid road surface of great durability. On the stand of Thorium Ltd. were samples of electromagnetically concentrated monazite sand from Travancore, South India. This sand contains about 9.5 per cent of thoria and 60 per cent of other rare earths. It is the raw material for the production of thoria and thorium salts, especially the nitrate.

Among the new developments in the British chemical industry during the past year attention may be directed to the preparation of crystalline soda by a new process, the commencement of commercial production of oxalic acid and the manufacture of metallic magnesium. The development of oil from coal processes has continued, and an entirely new angle in this development is the production of methanol instead of petrol. Interesting developments in the dye-stuffs field are the introduction of a new range of dye-stuffs for leather, for which advantages are claimed, and of a new range of dye-stuffs for the direct dyeing of acetate rayon.

Coming to the scientific instruments section of the Fair, one may note what has been noted before, namely, the enormous advantage obtained from a combined exhibit and also, alas, the continued absence of some firms whom anyone familiar with British scientific instruments would expect to find represented. Nevertheless, great credit is due to the organizers of

this section of the Exhibition for a most impressive and widely varied display. Chance Bros. and Co. Ltd. produced a striking effect by exhibiting under strong illumination a broken mass of optical glass as it leaves the pot. There was this year perhaps an even better display than usual of microscopes, photographic lenses, epidiascopes and cameras. In addition to their usual massive model, Ross Ltd. exhibited a classroom epidiascope. This instrument is designed for small classroom work and is very portable. It has a 500-watt lamp, and the change-over from episcopes to diascope is instantaneous. The maximum 'throw' of the picture is about twenty feet. Charles Baker showed an 'introscope', an instrument for inspecting the interiors of boiler tubes, ship shaftings, oxygen bottles and aeroplane spars, etc. By means of this instrument, it is possible to illuminate and examine microscopically surfaces which cannot easily be inspected in other circumstances. The instrument is made in lengths from 2 feet up to 33 feet.

A remarkable camera was shown by W. Vinten, Ltd. This camera takes 3,000 pictures per second and holds 400 feet of film, which is exhausted in 2½ seconds. The movement is continuous and at top speed reaches 120 miles per hour, the spool centres rotating at 15,000 revolutions per minute. There is a battery of 38 lenses, mounted on a rotating disc which runs at very nearly the same speed as the film. This camera is being used, among other purposes, for the study of important experiments in high-speed engines.

Among the chemical balances shown by L. Oertling, Ltd., there was a prismatic reflecting microbalance, which gives direct readings to 0.001 mgm. on the scale at the top of the balance case. It is claimed that this is the only balance in the world to read direct to 0.001 mgm. The capacity of the balance is 10 gm. and it is being much used in cancer research and in other problems of micro-chemistry. Kalee Ltd. exhibited a new production, namely, a high intensity reflector arc lamp, for use in cinematography. It is claimed that this lamp provides maximum illumination with comparatively low current consumption. Among the distinguishing features of this lamp may be noticed the embodiment of a short-focus, elliptical mirror. This provides for light collection from a wide angle, and has a further virtue that it dispenses with the use of the usual condenser lens for the focusing of the light on the film. Very thin carbon rods are used, and the mountings for the carbon rods are similarly reduced in size, so as to give the minimum interference with the projected light. The revolving sector is placed between the mirror and the projection lens system, instead of in front of the lenses, and thus helps to reduce the quantity of light entering the lenses with detrimental heating effects. On the stall of Theodore Hamblin, Ltd., an exhibit of novel interest was a binocular polarizing pool gazer. It is well-known that, when a fisherman looks at the surface of a pool of water, light from the sun and sky is frequently reflected from it as a dazzling glare, which prevents objects in the water from being seen. By the use of the polarizing binocular, these reflections are

eliminated, and the pool gazer has a clear view of what lies beneath the surface. One must not forget to direct attention to the great developments that have been made within the last year in the applications of 'Perspex', the synthetic product having the appearance and most of the properties of glass, without its defects, to which reference was made last year. A new method has been devised of making optical lenses from this material (see NATURE, February 20,

p. 336), and it will be a matter of much interest to watch how far it can be used in optical instruments of precision.

On the whole, one's impression is that those industries which may be regarded as more or less specifically scientific are in step with the general advance of industry and, in particular, alive to the opportunities created for new and, in some cases, striking developments.

## Figures of the Earth and Moon

A RECENT paper by Dr. Harold Jeffreys (*Mon. Not. Roy. Astro. Soc.*, 97, 1; 1936) deals with some well-known articles by de Sitter (*Bull. Astr. Soc. Neth.*, 2, 55; 4, 129. Also *K. Akad. Wetens. Amst.*, 17). De Sitter assumed hydrostatic stress in the earth's interior, and computed the ellipticity and related constants from the precessional constant. On comparing the results with the motion of the moon's node and perigee, the greater part of which can be explained by Brown's theory, there is a balance depending upon the figures of the earth and moon. The former was taken by de Sitter to be calculable from his theory, and the small balance he attributed to the moon's ellipticities. As Jeffreys points out, however, the assumption of hydrostatic stress in the interior does not agree with other data. For example, accepting his solution, the probable error of the difference between gravity at the poles and at the equator is 1 milligal ( $0.001 \text{ cm./sec.}^2$ ), but Heiskanen's ellipticity of the equator alone gives a variation of 38 milligals at the extremes. In addition, the relativity correction was applied by de Sitter with the wrong sign, a fact which he pointed out to Jeffreys about five years ago, and this produced errors in some of the constants.

Jeffreys deals with the problem in a very thorough manner, certain geophysical information being now available which was unknown to de Sitter, and arrives at some interesting results. Although de Sitter made

use of erroneous data which rendered his theory of the figure of the earth a little unsatisfactory, nevertheless the main ellipticity effects do not show much departure from his theory. The ellipticity of the earth is found to be  $1/296.38 \pm 0.51$ , and the corresponding gravity formula is

$$g = 978.051 \{1 + (0.005282 \pm 0.000006) \sin^2 \phi - 0.000007 \sin^2 2\phi\}.$$

He thinks that the accuracy of the formula is genuine so far as the term in  $\sin^2 \phi$  is concerned. Other formulae may suffer from greater inaccuracies because the methods of analysis may fail to allow for other terms.

Dealing with the moon, Jeffreys finds that the ellipticity of the equator is only about one-sixth that of the disk, and from this he concludes that when the moon solidified it was in a state of free rotation, the period being 3.5 days. In "The Earth" (second ed., pp. 228-9) he finds that the moon last adjusted itself to the hydrostatic state when its distance from the earth was about 87,000 miles, and its period of revolution and rotation 6.3 days. However, as he points out, the solution providing 3.5 days is only an *ad hoc* hypothesis. La Place's suggestion that the excess ellipticity may be due to random changes during solidification is probably as near the truth as Jeffreys's hypothesis. Obviously further research will modify some of the results which have been attained.

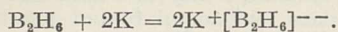
## Hydrides of Boron

IN the December issue of the *Berichte der deutschen chemischen Gesellschaft*, Dr. E. Wiberg reviews at considerable length the experimental evidence from which the structure of the puzzling hydrides of boron may be deduced. That considerable difficulty has been encountered during the last decade in formulating the electronic structure of these compounds will be apparent from the fact that such unsatisfactory devices as singlet linkages, polyvalent hydrogen, a co-ordination number of five for boron, electronic septets, even the sharing of *K*-electrons, a new but unexplained kind of 'electrostatic-electromagnetic' valency and inequality of the two boron atoms, have all been requisitioned at various times in order to find plausible explanations of the existence of the simple compound known, perhaps wrongly, as boroethane,  $B_2H_6$ .

Recent work has thrown new light upon this problem, which has been greatly simplified. The author brings forward both chemical and physical evidence to show that, instead of ethane, one should rather regard ethylene as the carbon analogue of diborane (boroethane), since it possesses an unsaturated character; but the analogy should not be pushed too far, since the boron hydrides are also acids. Their acidic character has been rather concealed by the fact that their salts are very easily decomposed by water, but they combine with ammonia to form true salts. Thus diborane combines with two and tetraborane with four molecules of ammonia to form salts, which are electrolytes when dissolved in liquid ammonia although water decomposes them. That they are indeed ammonium salts rather than amines is shown by the fact that an

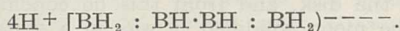
ammoniacal solution of borontrimethylmonoamine is non-conducting. Thus diborane is a dibasic, tetraborane a tetrabasic acid, and they may be formulated thus:  $H_2[B_2H_4]$  and  $H_4[B_4H_6]$ .

The unsaturated character of these hydrides has been proved by both spectroscopic and chemical evidence. Thus diborane and ethylene give similar absorption bands, where ethane shows none at all, in the region between 210 and 186  $\mu$ . Moreover, when shaken with alkali amalgam, the boranes react additively with the alkali metals thus:



A molecular weight determination deduced from measurement of its diamagnetic susceptibility shows that the borane molecule has not been ruptured into simpler molecules in this reaction. The resulting potassium salt can be sublimed unchanged at about 400° C., so that the bivalent negative ion  $B_2H_6^{--}$  with an ethane-like structure is much more stable than the unsaturated 'ethylenic' molecule  $B_2H_6$ , for which the formula  $2H^+[BH_2: BH_2]^{--}$  must now be adopted.

The unsaturated character of diborane accounts also for its reactions with water and with hydrogen chloride, since in both cases the additive products which are first formed split off hydrogen to produce a new unsaturated product; this then reacts further in the same way until we arrive at boric acid or boron polyhalides as final products. Some of the intermediate compounds have even been isolated. Similarly, the formula of tetraborane is written thus:



Two different groups of hydrides have been recognized, corresponding with the general formulæ  $B_nH_{n+4}$  and  $B_nH_{n+6}$ . At present, only the first members of each group have been investigated experimentally, but in both cases the chemical evidence has been supported by that based on measurements of parachor, dipole moments, magnetic properties and ultra-violet absorption spectra.

## Plankton Research and Sea Fisheries

A RECENT publication by R. E. Savage and R. S. Wimpenny ("Phytoplankton and the Herring", Part 2 (1933 and 1934), *Min. Agric. Fish., Fishery Invest.*, Ser. II, 15, No. 1 (1936), pp. 1-88. London: H.M. Stationery Office, 1936. 4s. 6d.) gives detailed information on the plankton conditions in the southern North Sea and their relations with the herring fishery in the years 1933 and 1934. This is a continuation of work already begun in 1921 and follows on a previous report for the years 1921-32.

The year 1933 was remarkable for unusually dense patches of the diatoms *Rhizosolenia styliformis* and *Biddulphia sinensis*. The former is associated with the current system in the neighbourhood of the south-west Dogger Bank Swirl; and the unusual degree of production in 1933 appeared to owe its origin to a strong incursion of oceanic bottom water, from the north, rich in nutrient salts. The arrival of the East Anglian herring shoals was delayed by these diatom patches in October 1933. A remarkable condition is recorded in May 1933, when a large area was covered with masses of the diatom *Coscinodiscus concinnus* to a depth of four feet, in which several guillemots and puffins were found floating dead. This was apparently being eaten by fulmar petrels.

Increasing attention to detail in this long-continued plankton programme is producing indications of new lines for research. The relation between the distribution and drift of the plankton with the water circulation is gradually being disclosed, as well as certain interrelationships between the phytoplankton and the zooplankton which call for further observation. Notable among these is evidence that higher proportions of the eggs and young stages of plankton animals are to be found within the diatom patches than in the surrounding areas. Adult plankton animals and herrings also appear to be massed against the edges of the phytoplankton patches. Evidence is forthcoming that the distribution of the young stages of the animals may be associated with the high oxygen content of the diatom patches.

The authors intend to investigate this problem further, but whatever be the true significance, it is clear that this continued routine research is developing on expanding lines which will lead to a better understanding of the biology of the plankton in the future. The work is carried on throughout in close collaboration with the hydrographers.

## University Events

LONDON.—The title of professor of biochemistry in the University has been conferred on Dr. A. C. Chibnall in respect of the post held by him at the Imperial College—Royal College of Science.

The title of emeritus professor of mining geology in the University has been conferred on Prof. C. G. Cullis, on his retirement from the University professorship of mining geology at the Imperial College—Royal College of Science.

Dr. F. G. Gregory has been appointed as from October 1 to the University chair of plant physiology tenable at the Imperial College—Royal College of Science. Since 1931, he has been assistant director of the Research Institute of Plant Physiology at the Imperial College.

The following have been appointed fellows of King's College: Prof. F. A. P. Aveling, professor of psychology since 1931; Miss Agnes S. Paul, lecturer in classics since 1932; Col. G. S. Szlumper, assistant general manager of the Southern Railway, and a vice-president of the Engineering Branch of the Old Students' Association; Mr. S. J. Worsley, academic registrar and acting principal of the University.

Prof. Raymond Pearl, professor of biology in the School of Hygiene and Public Health of Johns Hopkins University, has been appointed Heath Clark lecturer for the year 1937.

The degree of D.Sc. in mathematics has been conferred on A. C. Offord, of University College, and that of D.Sc. in physiology on Miss M. M. A. Murray, a recognized teacher at Bedford College.

OXFORD.—Prof. A. G. Tansley, Sherardian professor of botany and fellow of Magdalen College since 1927, is retiring under the age-limit as from July 31, 1937. Applications for the vacant professorship should reach the Registrar by April 17. The Board of the Faculty of Biological Sciences has recommended that the new professor should be primarily an ecologist.

The Nuffield professors, Prof. H. W. B. Cairns, Balliol, and Prof. R. R. Macintosh, Pembroke, and also Dr. S. Zuckerman, Christ Church, have received the degree of M.A. by decree.

## Science News a Century Ago

### Tunnels and Health

THE following extract is taken from a report issued on February 21, 1837, by Dr. John Ayrton Paris, Dr. Thomas Watson, Mr. William Lawrence, Mr. R. Phillips and Mr. W. Owen Lucas on the Primrose Hill Tunnel on the London and Birmingham Railway, which they had examined in order to ascertain the probable effect of such tunnels upon the health and feelings of the passengers: "We found the atmosphere of the Tunnel dry, and of an agreeable temperature, and free from smell; the lamps of the carriages were lighted; and in our transit inwards and back again to the mouth of the Tunnel, the sensation experienced was exactly that of travelling in a coach by night, between the walls of a narrow street. The noise did not prevent easy conversation, nor appear to be much greater in the Tunnel than in the open air. Judging from this experience and knowing the ease and certainty with which thorough ventilation may be effected, we are decidedly of the opinion that the dangers incurred in passing through well constructed Tunnels are no greater than those incurred in ordinary travelling upon an open railway or upon a turnpike-road; and that the apprehensions which have been expressed that such Tunnels are likely to prove detrimental to the health, or inconvenient to the feelings of those who may go through them, are perfectly futile and groundless." This report was not published in a contemporary medical journal, but is to be found among the reports in the library of the Royal Society of Medicine.

A similarly favourable report was issued the same day by Dr. John Davy and Dr. R. W. Rothman, and on February 19 by Dr. James Williamson on the Tunnel on the Leeds and Selby Railway.

### Alexander Burnes in Sind

At a meeting of the Royal Geographical Society held on February 27, 1837, a paper was read by Captain (afterwards Sir) Alexander Burnes (1805-41) on his exploration of Scinde (Sind). After describing the River Indus, and the character of the surrounding country, Burnes gave an account of the people. The inhabitants, he said, were chiefly Mohammedans, about one fourth being Hindus. Syúds and fakirs were respected to veneration; many doubtless were virtuous, but the bulk he feared were hypocritical fanatics. The mendicants were more numerous than in any other country in Asia. They could scarcely be called beggars, for they demanded tribute in crowds and by threats and with great arrogance. The Government was despotic and oppressive; trade and agriculture languished under it.

It was the disordered state of Scinde which led to the expedition of General Sir Charles Napier (1782-1853) in 1842 and the annexation of the province.

### Clarke's Electrical Measuring Instruments

WRITING on February 28, 1837, from the Laboratory of Science, Lowther Arcade, London, to William Sturgeon, the founder of *Sturgeon's Annals*, E. M. Clarke said: "As almost every scientific inquirer is at present directing his attention to the construction of electric batteries, and as in my opinion there is no correct measurer of their relative merits, I beg leave to submit to the notice of your very numerous

readers two instruments which I have constructed for that purpose."

The first of the instruments Clarke described he called a thermo-electrometer. It consisted of a length of platina wire about 1/90 in. in diameter stretched between two terminals supported on the upper edge of a scale marked in feet and inches. The current flowing from the battery was measured by the length of wire made red in darkness, or burned.

The second instrument was described as an electro-gasometer, the current being measured by the amount of gases given off when the current was passed from one platina plate to another in water. This instrument Clarke said he had constructed "from having seen a very imperfect one at the Royal Institution made out of a two-necked bottle with platina electrodes passing through the holes drilled in the graduated glass tube". Descriptions and sketches of the instruments are given in vol. 1 of *Sturgeon's Annals*.

### An Investigation into Animal Magnetism

A CERTAIN M. Berna having set forth claims regarding animal magnetisms somewhat akin to those previously made by Friedrich Anton Mesmer (1734-1815), the author of the doctrine of animal magnetism, or mesmerism, the Royal Academy of Medicine, Paris, appointed a commission under the presidency of M. Roux to inquire into the claims of M. Berna. The first of the meetings of the commission took place on March 3, 1837, and the commission reported to the Academy in August 1837. The report was printed in the "Annual Register", 1837. In the concluding paragraph it said that with reference to M. Berna's claims: "Those facts which he promised to show us are all known to you; you know as we do that they are anything but conclusive in favour of the doctrine of animal magnetism, and that they can have no relation either with physiology or with therapeutics."

### Education at Oxford

A LEADING article in the issue of the *British Annals of Medicine* for March 3, 1837, contains the following comment on contemporary medical education at Oxford: "Our readers cannot fail to have drawn some ominous conclusions from the facts detailed in the correspondence relative to Oxford, which has appeared in our pages. It is a fact, we believe, undeniable that several years ago the classes at that University were well attended, in the usual acceptation of the term, that of late the attendance has been gradually decaying and now threatens to convert the professorships into sinecures; that is, to take the professors away from Oxford, for we think this must soon occur if the signification of the term professor is not altered; as hitherto, at every university at home and abroad, so far as we can learn, the title of professor is alone bestowed on those who engage in the active duties of teaching literature and science. Even at present it does not appear that one half of the professors at Oxford ever lecture at all. These are melancholy facts, it may be admitted, but how are they to be remedied? A remedy can only be found by the agency of the professors themselves or by the agitation of those who are aggrieved. The former would effect the most speedy cure; their united complaint would not fail to be listened to by the Legislature. The Government could institute an inquiry by means of impartial agents."

## Societies and Academies

## London

Royal Society, February 18.

E. N. DA C. ANDRADE and R. C. PARKER: A standard source of sound and the measurement of minimum audibility. A source of sound has been constructed of which the energy output can be measured in absolute units. The air in a tube is maintained in vibration by means of a loudspeaker unit attached to one end: the other end is open, and serves as the source. The energy output is found by measuring the length of the traces of smoke particles at an antinode, the method being thus a very direct one. One of the difficulties is to ensure that a given current flowing through the speaker unit shall always produce the same amplitude. The source was calibrated in terms of the current supply by determining the currents corresponding to various measured amplitudes at fixed frequencies. It has been used to determine the least pressure variation detectable by the ear, under conditions free from background noise and unwanted reflections.

C. J. MILNER: The magneto-resistance effect in cadmium at low temperatures. Apparatus is described for measuring the increase of electrical resistance of specimens of cadmium, at low temperatures, in magnetic fields up to 26 kgauss. At temperatures above 20° K., Kapitza's observation, that for strong fields a linear variation of resistance with field strength replaces the initial square law, was confirmed. At helium temperatures a new effect was found. In addition to the linear effect mentioned, a square-law increase was observed, producing a very large increase of resistance in pure specimens. The increase of resistance could be represented as  $a.H^2 + b.H$ , where  $b$  is constant, and  $a$  is inversely proportional to the residual resistance of the specimen.  $a$  is constant at the lowest temperatures, but falls rapidly above 4° K. to negligible values;  $b$  varies only slightly with the temperature. The  $a$ -effect is absent when the magnetic field is parallel to the current, and the curve then shows a saturation effect, at helium temperatures. It would seem that the  $a$ -effect has previously been observed, though not recognized, in other metals of the non-cubic groups: but that the effect is absent or much smaller in the cubic metals, copper, silver, gold and aluminium.

## Edinburgh

Royal Society, February 1.

JAMES KENDALL: Ions and isotopes. No separation of isotopic ions was obtained by running a solution a considerable distance along a series of tubes; hence ionic mobility is fundamentally dependent upon volume, not upon mass. Many difficult separations, however, such as pairs of rare earth elements or radium from barium residues, were readily achieved by ionic migration. A slight separation of the isotopes of mercury by fractional electrolysis was obtained in 1923. Work on hydrogen was begun in 1930, but pure 'heavy hydrogen' was first isolated in America two years later.

A. GRAHAM: Ciliary currents on the gills of some Tellinacea (Lamellibranchiata). The relationship between the lamellibranch *Solecurtus* and the Tellinacea, evident on morphological grounds, is stressed by the arrangement of the frontal ciliary tracts on the outer gills, which in both groups beat towards

the ctenidial axis instead of to the free margin of the gill as normally. This supports the interpretation of the outer gill of Tellinacea as homologous with the supra-axial extension of other lamellibranchs and that of *Solecurtus* as a reduplication of the same structure.

## Paris

Academy of Sciences, January 25 (C.R., 204, 201-304).

EMILE BOREL: The imitation of chance.

ANTONIN GOSSET and LÉON BINET: The increase of the proportion of glutathione in the liver by treatment with sulphur compounds.

JEAN BAPTISTE SENDERENS: The catalytic decomposition of halogen-substituted acetic acids, in liquid systems. Details of the decomposition products of trichloroacetic, tribromoacetic and dichloroacetic acids when heated below their boiling points with various catalysts. The nature of the reaction varied with the catalyst; thus trichloroacetic with thoria gave phosgene, hydrochloric acid and carbon monoxide, while with activated carbon the products were carbon dioxide and chloroform.

MAURICE GIGNOUX and FRANCK BOURDIER: The Rhodanian fluvio-glacial formations in the neighbourhood of Bellegarde (Ain) and the neo-Würmian ice period.

MARC COURTAND: Left curves of the fourth order.

MAX EGER: Canonical systems of an algebraical variety.

JEAN LOUIS DESTOUCHES: Spaces with finite character.

LOUIS PASQUALINI: The conditions of convexity of a  $V_{p-1}$  variety of  $p-1$  dimensions immersed in Euclidian space  $R_p$  of  $p$  dimensions.

G. AVAKUMOVIĆ: Theorems relating to Laplace integrals on convergence boundaries.

NY TSI-ZE: The so-called circular transversal vibration of a hollow quartz cylinder.

LÉON BESCHKINE: Corrections to be applied to the general theorems utilized in resistance of materials when the displacements are not negligible.

EMILE SEVIN: Cosmic radiation and the stars of the principal series.

JEAN CICHOCKI: The latent energy of solid solutions.

JULES GÉHÉNIU: The production of electromagnetic waves by means of neutrinos.

ALBERT GRUMBACH and PIERRE VIDAL: A new method of preparing semipermeable membranes. The copper ferrocyanide membrane is formed by a special technique on a glass filtering plate, after the pores of the latter have been reduced by deposition of gelatinous silica.

MARCEL PAUTHENIER and CHARLES MARTIN: The limiting electric charge of very small particles.

JEAN CRUSSARD and LOUIS LEPRINCE-RINGUET: Study with the large Bellevue electromagnet of the passage through screens of the particles of cosmic radiation.

Mlle. SUZANNE VEIL: Some batteries with unlike electrodes.

Mlle. MARGUERITE PEREY: The spectra of barium and strontium.

PIERRE BARCHEWITZ: The absorption spectra of amines in the near infra-red. (6000-95,000 Å.)

GEORGES DÉCHENE: The extreme ultra-violet emitted by electrical discharges in air under reduced pressure.

T. NICOLAS PANAY. The continuous flame spectrum of potassium.



PAUL SOLEILLET: The mean duration of life of the zinc atom in the state  $2^3P_1$  and the method of total absorption. Discussion of the interpretation of the experiments of W. Billeter.

Mlle. YVETTE CAUCHOIS: Weak emissions in the L spectrum of rhenium (75).

PIERRE AUGER, PAUL EHRENFEST, JUN., ANDRÉ FEORN and ANDRÉ FOURNIER: The angular distribution of hard corpuscular cosmic rays.

JACQUES ERRERA and POL MOLLET: The (OH) band of monomolecules of alcohol in the region of  $3\mu$ .

MME. MARIE FREYMANN: The absorption spectra in the near infra-red of mixtures of amines and alcohols. The formation of ammonium compounds.

RENÉ DELAPLACE: The thermal conductivity of unsaturated hydrocarbons at low pressure.

HUBERT FORESTIER and RICHARD LILLE: The variation of the catalytic power of ferromagnetic bodies at the Curie point. Studies based on the reaction  $\text{CO}_2 + \text{H}_2 = \text{CO} + \text{H}_2\text{O}$  in the presence of various ferromagnetic oxides as catalysts. The variations of the catalytic activity of the three oxides used were shown to be related to the electronic phenomenon at the Curie point.

RENÉ PERRIN and JEAN LAMBERTON: Contribution to the study of the equilibria between metals and slags. Discussion as to the applicability of the law of mass action to metals in contact with slag.

EMILE CHERBULIEZ and MME. ANNA HERZENSTEIN: The detection and estimation of colloidal sulphur and of polysulphide sulphur in sulphurous waters.

GEORGES DARZENS and ANDRÉ LEVY: New researches on the condensation of dichloroacetic ester with ketones and aldehydes by magnesium amalgam.

J. D. H. DONNAY and DAVID HARKER: The generalization of the law of Bravais.

B. CHOUBERT: Graphical expression of regional metamorphism.

FRANCK BOURDIER: New observations on the extension of the ancient glaciers in the lower valley of the Isère.

GÉRARD WATERLOT: The age of the folds and faults of the Cambrian massif of Rocroi.

LOUIS DUBERTRET: Fragments of tectonic breccia at the surface of the green Syrian rocks.

HENRY HUBERT: Observations of detail on the bar of Dahomey.

PIERRE GAVAUDAN: The final condition of the nucleole during mitosis and its general relations with the thymonucleic chromatin.

THEODOR SOLACOLU and DÉMÈTRE CONSTANINESCO: Tumours with neoplastic characters formed on plants by the action of  $\beta$ -indolylacetic acid.

RENÉ SOUÈGES: The embryogeny of the *Dipsacaceæ*. The development of the embryo in *Scabiosa Succisa* L.

ALFRED BALACHOWSKY: The experimental rupture of the diapause in the caropcase or 'ver des pommes' (*Laspeyresia pomonella*).

GABRIEL GUIGNON and Mlle. ANNE RAFFY: The influence of the points of heating presented by the wings of diurnal Lepidoptera exposed to solar radiations on the power of flight of these insects.

MLADEN PAIĆ: The identification of the pigment elaborated by the diphtheria bacillus.

MAURICE DOLADILHE: A property of the viscous protein of syphilitic sera. It is shown that the substance imparting to a syphilitic serum characters of flocculation enabling it to be differentiated *in vitro* from a non-syphilitic serum, is localized in the viscous protein.

ANDRÉ BOIVIN and MME LYDIA MESROBEANU: The nature and biological properties of the toxins produced by the Shiga bacillus and by the Flexner bacillus.

#### Cracow

Polish Academy of Science and Letters, December 7.

S. K. ZAREMBA: Remarks on the approximate integration of differential equations.

K. KOZIEL: Gibbs's formulæ for the ratios  $n_1$  and  $n_2$  of the areas of triangles.

A. KOTECKI: New fluctuation bands in the spectrum of cadmium vapour.

Mlle. A. WRZESINSKA: Influence of the concentration on the distribution of the intensities in the photoluminescence spectrum of glycerol solutions of tryptaflavine.

S. DOBINSKI and J. WESOŁOWSKI: The coefficient of viscosity of liquid selenium. The viscosity-temperature curve does not show the irregularities found some time ago by Pelabon in his study of the electrical conductivity of selenium. Liquid selenium belongs to the second class of associated liquids according to Andrade's theory of viscosity.

L. MARCHLEWSKI and Mlle. R. GRÜNBAUM: Absorption of the ultra-violet rays by certain organic substances. (42) Datisetin, morin and quercetin.

MME. J. DYAKOWSKA: Researches on the velocity of the fall of pollen of several species of trees.

S. KRZEMIENIEWSKI and J. KOVATS: Action of iron and of molybdenum on the fixation of nitrogen by *Azotobacter*.

MME. Z. MALASZYNSKA-SUCHCITZ: Cytological researches on the tegumentary glands of the crayfish, and considerations on the role of the plasmatic structures.

R. TOWARNICKI: Structure of the hooked apparatus in the anterior part of the body of the larva of the blowfly (*Calliphora vomitoria*).

#### Rome

Royal National Academy of the Lincei  
(*Atti*, 23, 721-806; 1936).

W. BLASCHKE: Contribution to integral kinematics.  
G. ZWIRNER: Integration of a matrix according to Volterra.

G. LAMPARIELLO: A theorem of statics of van den Dungen.

B. FINZI: Dispersion of a vortex in a plastic medium.  
E. FROLA: Certain integrals capable of resolving the dynamic problem of bent beams (1). The equation  $(C(x)y'(x))' = -\lambda M(x) \sin y(x)$ ;  $y(0) = y(1) = 0(2)$ .

G. KRALL: Vibrations induced by inert and lightened loads which are in motion on a bridge.

L. GIALANELLA: Meridian observations of Jupiter and of Vesta in 1935.

I. CASTELLI: Equivalent widths and central intensities of absorption lines in the solar spectrum at the centre and at the edges.

G. C. WICK: Diffusion of slow neutrons.

P. GUARESCHI: Calculation of latent heats of evaporation.

G. CENTOLA: Structure of acetyl cellulose soluble in acetone, or 'cellite'.

F. PENTA: Fossil carbon in the Mesozoic of Longobucco in Calabria.

G. LANDRA: The tricocicloforus of Sergio Sergi and its first application. The use of this instrument for measuring dimensions of hair in anthropological studies is described.

## Forthcoming Events

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

## Monday, March 1

MUSEUMS ASSOCIATION, at 5.—Peter Holm: "The Old Town: a Folk Museum in Denmark".\*

UNIVERSITY OF LEEDS, at 5.15.—Prof. A. H. Gibson: "The Use of Working Models in Engineering".\*

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—G. C. Schluter: "On Safari in East Africa" (Geographical Film).

SWINEY LECTURES ON GEOLOGY, at 5.30—(at the Imperial College of Science, Exhibition Road, South Kensington, S.W.7).—Dr. Frederick Walker: "Ice Ages" (succeeding lectures on March 3, 5, 8, 10, 12, 15, 17, 19, 22 and 24).\*

KING'S COLLEGE, LONDON, at 5.30.—Dr. W. A. J. M. van Waterschoot van der Gracht: "The Sub-Surface Structure and the Sediments of the Great Basin of North-Western Europe (including the North Sea and Eastern Lowlands of England)" (succeeding lectures on March 2 and 3).\*

ROYAL SOCIETY OF ARTS, at 8.—F. I. G. Rawlins: "The Physics and Chemistry of Paintings" (Cantor Lectures. Succeeding lectures on March 10 and 15).

## Tuesday, March 2

ROYAL SOCIETY OF ARTS, at 4.30.—R. E. H. Baily: "The Anglo-Egyptian Sudan."

GRESHAM COLLEGE, LONDON, E.C.2, at 6.—A. R. Hinks, F.R.S.: "Studies of the Solar System" (succeeding lectures on March 3, 4 and 5).\*

INSTITUTION OF CIVIL ENGINEERS, at 7—(at the Royal Geographical Society, Kensington Gore, S.W.7).—Symposium on "Research in Connexion with Motor Vehicles".

## Wednesday, March 3

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION), at 6.—Commander F. G. Loring, W. L. McPherson and W. H. McAllister: "A Survey of Marine Radio Progress, with Special Reference to R.M.S. *Queen Mary*".

## Thursday, March 4

ROYAL SOCIETY, at 4.—Discussion on "Beta Transformations of Atomic Nuclei", to be opened by Prof. C. D. Ellis, F.R.S.

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. K. von Frisch: "The Sense of Hearing in Fishes".\*

CHEMICAL SOCIETY, at 8.—Prof. H. S. Raper, F.R.S.: "Some Problems of Tyrosine Metabolism".

## Friday, March 5

ROYAL SOCIETY OF ARTS, at 4.30.—Dr. E. J. H. Mackay: "Excavations at Chanhu-daro".

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS, at 5.45—(in the Chemical Society's Rooms, Burlington House, Piccadilly, W.1).—Annual General Meeting.

Prof. G. Barger, F.R.S.: "The Alkaloids of Ergot".

BEDSON CLUB (ARMSTRONG COLLEGE, NEWCASTLE-UPON-TYNE), at 6.30.—W. T. Astbury: "The X-Ray Interpretation of Protein Structure" (Thirty-seventh Bedson Lecture).

GEOLOGISTS' ASSOCIATION, at 7.30—(at University College, Gower Street, London, W.C.1).—Annual General Meeting.

P. McIntyre: "Between the Forth and the Tay".

ROYAL INSTITUTION, at 9.—Prof. G. I. Finch: "Electron Diffraction and Surface Structure".

## Appointments Vacant

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

LECTURER IN CHEMISTRY, BIOLOGY AND PHYSICS in the Doncaster Technical College—The Secretary, Education Offices, Doncaster, Yorks. (March 5).

ASSISTANT CURATOR in the Plymouth Museums and Art Galleries—The Town Clerk, Municipal Buildings, Plymouth (March 9).

PRINCIPAL TEACHER OF MINING in the Batley Technical College and the Huddersfield Technical College—The Director of Education, Education Offices, Batley (March 9).

CONSULTING PHYSICIST at the Royal Northern Hospital, Holloway, London, N.7—The Secretary (March 12).

ASSISTANT KEEPER (INDUSTRIAL ENGINEERING) in the Science Museum, South Kensington, London, S.W.7—The Director (March 15).

REGIUS PROFESSOR OF MATERIA MEDICA in the University of Glasgow—The Private Secretary, Scottish Office, Whitehall, London, S.W.1 (March 31).

SHERARDIAN PROFESSOR OF BOTANY in the University of Oxford—The Registrar, University Registry, Oxford (April 17).

LECTURER IN GEOGRAPHY in University College, Rangoon—The Secretary, Universities Bureau of the British Empire, 88a, Gower Street, London, W.C.1.

## Official Publications Received

## Great Britain and Ireland

The National Smoke Abatement Society. Seventh Annual Report, 1936-7. Pp. 28. (Manchester: National Smoke Abatement Society.) [261]

Technical Publications of the International Tin Research and Development Council. Series A, No. 49: Discoloration and Corrosion in Canned Cream. By C. J. Jackson, G. R. Howat and T. P. Hoar. Pp. 10+2 plates. (London: International Tin Research and Development Council.) Free. [261]

Memoirs of the Royal Meteorological Society. Vol. 4, No. 39: World Weather, VI. The Discussion by Sir Gilbert T. Walker; and the Tabulation by E. W. Bliss. Pp. 119-140. (London: Royal Meteorological Society.) 2s. 6d. [22]

## Other Countries

Smithsonian Miscellaneous Collections. Vol. 95, No. 19: Cycles in Tree-Ring Widths. By C. G. Abbot. (Publication 3402). Pp. ii+5. (Washington, D.C.: Smithsonian Institution.) [271]

Proceedings of the United States National Museum. Vol. 84, No. 3005: The Nest of *Odynerus tempiferus* var. *maioi* Bequaert, with Notes on the Habits of the Wasps. By Austin H. Clark and Grace A. Sandhouse. Pp. 89-95. (Washington, D.C.: Government Printing Office.) [271]

Ministry of Agriculture, Egypt: Technical and Scientific Service, Bulletin No. 44: The Propagation and Cultivation of Citrus Trees in Egypt. By Thos. W. Brown. Second edition, revised and put up to date by the Author and Dr. Abbas El Sawy. Pp. xi+96+73 plates. (Cairo: Government Press.) 15 P.T. [281]

The Science Reports of the Tôhoku Imperial University, Sendai. First Series. Anniversary Volume dedicated to Prof. Kôtarô Honda on the completion of Twenty-five Years of his Professorship. By his Friends and Pupils. Pp. xix+1126. (Tôhoku and Sendai: Maruzen Co., Ltd.) [281]

Memoirs of the Kyancutta Museum. No. 3: Further Notes on Cyathospongia (Archaeocyathi) and other Organisms from the Lower Cambrian of Beltana, South Australia. By R. and J. Bedford. Pp. 21-26+plates 21-26. (Kyancutta: Kyancutta Museum.) 2s. [22]

Report of the Botanical Survey of India for 1934-35. Pp. 18. (Calcutta: Government of India Press.) [22]

Kungl. Svenska Vetenskapsakademiens Handlingar. Serien 3, Band 15, No. 6: Une méthode nouvelle de l'optique géométrique. Par C. W. Oseen. Pp. 41. Serien 3, Band 16, No. 1: On the Morphology of Triassic Stegocephalians from Spitsbergen, and the Interpretation of the Endocranium in the Labyrinthodontia. By G. Sæve-Søderbergh. Pp. 181+22 plates. (Stockholm: Almqvist and Wiksells Boktryckeri A.-B.) [22]

Proceedings of the United States National Museum. Vol. 84, No. 3003: Two New Species of Hawks from the Miocene of Nebraska. By Alexander Wetmore. Pp. 73-78. Vol. 84, No. 3004: A New North American Mason-Wasp from Virginia, with Notes on some Allied Forms. By Joseph Bequaert. Pp. 79-88. (Washington, D.C.: Government Printing Office.) [22]

U.S. Department of Agriculture. Technical Bulletin No. 530: Selenium Occurrence in certain Soils in the United States, with a Discussion of Related Topics. Second Report. By Horace G. Byers. Pp. 79. (Washington, D.C.: Government Printing Office.) 10 cents. [22]

## Catalogues

Iodatol: Prepared specially for use in Radiological Diagnosis and in Iodine Therapy. Pp. 12. (London: The British Drug Houses, Ltd.)

Neuerscheinungen 1936. Mathematik: Physik. Pp. 23. Chemie: Chemische Technologie. Pp. 24. (Berlin und Wien: Julius Springer.) Das neue Buch 1936. Pp. 24. Das neue Buch 1937, Erste Liste. Pp. 6. (Berlin: Ernst Rowohlt.)

Ovarian Hormones in Clinical Practice. Pp. 20. (Nottingham: Boots Pure Drug Co., Ltd.)