

Editorial & Publishing Offices :

MACMILLAN & Co., LTD.  
ST. MARTIN'S STREET  
LONDON, W.C.2



Telegraphic Address :  
PHUSIS, LESQUARE, LONDON

Telephone Number :  
WHITEHALL 8831

No. 3504

SATURDAY, DECEMBER 26, 1936

Vol. 138

## Rearmament and the League of Nations

ALTHOUGH general, but by no means unqualified, support has been given to the Government's programme of rearmament, the impossibility of attaining security in this way alone is fully appreciated by all thoughtful opinion; and much of the support of the Government is conditional upon its efforts to promote collective security and the methods of peaceful change which will diminish the causes of international friction and misunderstanding. Misgivings about the extent of the Government's constructive effort in this field are, however, still apparent.

Unless men are sane enough to recognize that under modern conditions the changed nature of modern warfare makes its renunciation as an instrument of national policy not merely an ideal but also an essential, catastrophe cannot be averted. The most untoward consequence of the present concentration of effort on national rearmament is that it distracts attention from the underlying issues and constructive efforts to find a real basis for peace. Rearmament is at best a counsel of desperation, and no Government to-day has discharged its obligations in the matter of national defence if it has not at the same time explored to the utmost the possibilities not merely of collective defence and security but also of the removal of causes of international friction and of the organization of peace.

The limitations of rearmament, however, are none the less made manifest from time to time, as in the recently published report of the sub-committee of the Committee of Imperial Defence on the vulnerability of capital ships to air attack. While no ship is less likely to be destroyed by air attack than the heavy battleship, the report is on the whole inconclusive. On the high seas, in

the main, an air force is still unable to perform the functions of a navy, but the vital question of vulnerability in the narrow seas around the coasts of Great Britain remains undetermined. The sub-committee considers that the day of the capital ship is not over, now or in the near future, but it is clear that while impressed with the vulnerability of the battleship to concentrated air attack under favourable conditions, the Committee merely shrinks from making a decision where the consequences of a mistake might be so serious.

The very inconclusiveness of the report indicates, however, the changed position of Great Britain in regard to defence. Its insularity has gone for ever, and now the ability of the Navy to perform its time-honoured functions can be called in question without instant refutation. Moreover, evidence provided by such a report is very welcome as coming from those the sincerity of whose efforts to secure effective defence cannot be questioned.

This is, in fact, one of the most untoward consequences of the political discussion of rearmament. There is a disposition to assume that those who doubt or deny the possibility of effective aerial or naval defence under modern conditions are anxious to commit the country to the opposite policy of pacificism, and to overlook the extreme dangers which Fascism and militarism offer to the best in man's heritage to-day. Accordingly, Mr. Jonathan Griffin's "Alternative to Rearmament"\* is to be welcomed as a vigorous demonstration of a constructive alternative policy which should commend itself to a great body of moderate opinion in Great Britain which, while convinced of the necessity of improving defence, is indis-

\* Alternative to Rearmament. By Jonathan Griffin. Pp. xii + 215. (London: Macmillan and Co., Ltd., 1936.) 6s. net.



posed to afford the militarists *carte blanche* and realizes that rearmament alone can offer no solution.

Mr. Griffin is under no illusions as to the consequences of rearmament, and quotes comprehensively from authorities to demonstrate the extreme vulnerability of Great Britain to air attack, and the impossibility of any really effective defence. He does not, however, urge that the only policy is one of developing our air forces so as to be capable of rendering instant and equally heavy reprisals. On the contrary, he argues convincingly that to rearm with bombers in this fashion would almost certainly precipitate conflict, and he urges accordingly that our policy should be to concentrate on the measures which would make this country less vulnerable but which would not be construed as a threat to other countries.

On the question of defence without menace, Mr. Griffin makes numerous constructive proposals. He questions the utility of those air-raid precautions which undermine liberty, such as masks and drills, which he stigmatizes as deception, not defence. He urges instead the duplication, dispersal and protection of essential public services and buildings; development of fire-fighting services; exploration of the possibilities of search-lights; the rebuilding or evacuation of great towns; the development of anti-aircraft guns; provision of fighting planes instead of bombers, and above all the adequate organization of the storage of food. If we could store a year's food supply, we should be freed from dependence on the doubtful ability of the Navy to fill its old functions, and in this we should be offering no menace to other countries.

The defence policy advocated thus aims at saving life, not at maintaining morale, and it is insisted that we should avoid measures involving education of the public in passive defence as much as that the policy outlined should be used as an alternative to rearmament. Rearmament should only be permitted on the condition that menacing armaments are definitely limited and co-ordinated for collective security; that there should be no provocation except sanctions against an aggressor; no commitments except the Covenant of the League and a Europe-wide system of collective security against aggression from the air.

On many of these points it is clear that Mr. Griffin is already assured of the support of scientific workers who have devoted attention to this question, and his statement is to be commended

to the growing number of scientific workers who are concerned about the prostitution of scientific effort for war purposes and look for some solution which offers a chance of constructive effort for peace and security, and who are prepared to take trouble to sift out the facts from the prejudices in which they are so often embedded.

Many of Mr. Griffin's arguments are underlined in the restatement by Lord Davies of views on the relations of force and law in the light of the unhappy experience of the Italo-Abyssinian conflict\*. While he contributes little that is new, Lord Davies, without dwelling unduly on the mistakes of the past, emphasizes the steps which can and must be taken to prevent a like outrage again endangering the foundations of our common security and order. No reader of this book can be blind to the mistakes which Great Britain, though not this country alone, has made, and its failure to render wholehearted and unambiguous support of the collective principle at decisive moments.

Here again is the constructive and practical outlook which scientific workers should welcome. The case for federation and an international police force is set forth with an urgency and relevance which are fresh and effective, even to those familiar with Lord Davies's earlier books. Notably is this true of his discussion of the reform of the League, the present ineffectiveness of which he attributes, after the reluctance of certain powerful members to use the machinery already existing, to the absence of federation in Europe. A new and reformed League must be based on an impartial exploration of the possibilities of the federal system in Europe. Much indeed could be done within the framework of the present Government, and the book contains trenchant criticism of the premature judgment passed on the sanctions system from an experience of its very limited and partial application.

Like Mr. Griffin's book, "Nearing the Abyss" is a challenge to further thought and investigation on vital matters while yet there is time, and both books will indicate fields in which the help of scientific workers is welcome if not essential. Equally impressive is the plea which Mr. C. R. Buxton has recently entered† for an exploration of the possibilities and mechanism of peaceful change in such fields as access to raw materials, population, mandates and the like.

\* *Nearing the Abyss: the Lesson of Ethiopia*. By Lord Davies. Pp. xiii + 182. (London: Constable and Co., Ltd., 1936.) 3s. 6d. net.

† *The Alternative to War: a Programme for Statesmen*. By C. R. Buxton. Pp. 176. (London: George Allen and Unwin, Ltd., 1936.) 4s. 6d. net.



Scientific workers who will take the trouble to examine the material now available, in these three books and elsewhere, cannot fail to realize how wide is the field awaiting the application of the scientific spirit and the scientific method, or to

find some section of the field in which their own contribution might be made to national defence and security, and the development of that educated opinion upon which alone all constructive effort must rest.

## Ancient Buildings in Scotland and England

THE discussion which took place in the House of Lords on December 2, when the question was raised as to the preservation of ancient structures in Scotland and England, while achieving little in the way of immediate action, the motions upon which debate arose being by leave withdrawn, was far from abortive. It served emphatically to direct public attention to an irretrievable loss of material of historic or æsthetic value, especially in Scotland, and in the replies elicited from the representatives of the Government, afforded hope of official support and co-operation in the efforts which are being made to avert further destruction, even though the prospects of financial assistance from the Treasury are not encouraging.

The debate was, perhaps, most useful in clearing the way for further action and in suggesting lines along which further effort might be directed. The problems in the two countries, though very similar, are not identical. Whereas in England the question before the House was concerned only with structures of the eighteenth century, in Scotland material surviving from the whole historic period is affected. In both instances, however, the structures are not 'historic' in the technical sense, or 'country houses', but examples of humbler domestic architecture—a class of building which in both rural and urban areas is of special importance for the cultural history of Scotland, where the strongly marked individuality of the people clearly has been affected distinctively by environmental influences. It was pointed out by Lord Hamilton of Dalzell and other members of their Lordships' House, who supported him, that during the last few years destruction has been taking place in Scotland wholesale and at an extremely rapid rate. "Old Scotland," said Lord Crawford, "is vanishing before our eyes."

The tragedy of this destruction lies in the fact that so often it is avoidable, but is justified as a public improvement, or amelioration of social conditions—road-making or widening and the

improvement or extension of housing accommodation for the poorer classes. In Scotland, more especially, Government financial assistance has been made available in a form which has acted as a spur to the destructive activities of local authorities, while the private owner, suffering under a public burden in the form of rates—payable in Scotland on empty property—has sought relief from an expense without return.

In his sympathetic reply on behalf of the Government, Lord Strathcona pointed out methods by which complete destruction of buildings worth preservation might be avoided without forfeiting assistance from the Treasury in certain classes of property, and indicated the extent of departmental supervision already exercised in endeavouring to secure that no historically interesting building should be demolished. The financial obligation, however, involved in any promise of financial assistance from the Government towards the cost of preservation is an uncertain factor, and the delay for which Lord Strathcona asked until the information now being collected by the National Trust is available, though unfortunate, is not unreasonable.

The First Commissioner of Works (Lord Stanhope), in dealing with the position of the eighteenth-century house in England, was less sympathetic, and in suggesting that effort should be directed to persuasion of the local authority, upon whom he sought to throw responsibility, he ignored past experience. For their notorious shortcomings in such matters, local authorities are not entirely to blame; and the time has surely come when the public may be regarded as sufficiently instructed in the value of its ancient treasures to accept the overriding verdict of a Department which speaks with full scientific and technical knowledge. The powers of the Office of Works as a protector of ancient structures should be enlarged to cover in some measure inhabited or habitable structures not contemplated in existing provision.



## The Impact of Civilization in Australia

### (1) North Australia

By C. Price Conigrave. Pp. 319+12 plates. (London: Jonathan Cape, Ltd., 1936.) 10s. 6d. net.

### (2) The Red Centre:

Man and Beast in the Heart of Australia. By H. H. Finlayson. Pp. 146+52 plates. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Co., 1935.) 7s. 6d.

### (3) All-About:

the Story of a Black Community on Argyle Station, Kimberley. By Mary and Elizabeth Durack. Pp. 105. (Sydney: The *Bulletin*, 1935.) 3s. 6d. net.

IN these three books Australia is presented from very different points of view; but the three have this in common—their authors are enthusiastic about their subject, and they succeed in conveying no little of their enthusiasm to their readers.

(1) Mr. Conigrave's book, though by no means heavy in treatment, aims at a more or less comprehensive survey of the history, character and resources of the Northern Territory. The story of its discovery, settlement and exploration, and of its fortunes under the administration of South Australia, are told in some detail, but without tedium. North Australia, as the author points out, is not well known, even to Australians, and lack of understanding has been a handicap throughout its history, which has not been removed entirely in the improved conditions under Federal Government. One great obstacle to development, especially of Port Darwin, is the failure to complete the trans-continental railway. There is still a gap of seven hundred miles between the ends of the northern and southern lines. Nevertheless, it will come as something of a surprise to most readers to find that in 1933 there were still only 3,306 inhabitants, apart from the aborigines. Notwithstanding the development of air traffic, Port Darwin, as the first great port of entry to the continent, has not yet come into its own.

Of the many problems for which the Federal Government made itself responsible when it took over the Northern Territory, that of the aborigines was not the least difficult. There are still some twenty thousand aborigines in the Territory. Mr. Conigrave, while admitting the cruelties and injustice meted out to the aboriginal in the early days of settlement, retorts to the criticisms of the South with the *tu quoque* of the complete extinction

of tribes in southern lands. Under the Federal Government and with a changing public opinion, he thinks, the aboriginal has a better chance of a fair deal. While the author allows certain good qualities and abilities to the blackfellow, he is, he maintains, an inferior type, which will answer the irresistible call of the white man's civilization, and then inevitably suffer degradation and ultimate extinction.

Is it true, however, that this fate is inevitable? Anthropological science maintains that study of aboriginal character, abilities and institutions, under sympathetic and understanding administration, will go as far as is humanly possible to ensure that changes are along lines which will develop rather than destroy, and, it may be, provide what will prove ultimately an asset in the economy of the State. It is, therefore, gratifying to note that one recommendation made by the author, the reform of judicial procedure in aboriginal criminal cases, has been carried out since he wrote, on lines which would commend themselves to him, by the appointment of an anthropologist to be responsible for investigation and disciplinary measures in all but the most serious cases of aboriginal crime. Further, the administrative changes now being made by the Federal Government should mitigate the destructive impact of white civilization.

(2) Mr. Finlayson has a story to tell which differs essentially from that of Mr. Conigrave; and the difference is not merely that of environment, although his scene is set in the central desert—the 'Red Centre'. If Mr. Conigrave aims at showing what has been gained for Australia through civilization in the development of a once isolated tropical land, Mr. Finlayson, in his turn, shows how some of the most characteristic features of wild life in Australia are being lost rapidly through civilization, even though in the attenuated form of such settlement as is possible in an arid or semi-arid land. The mammalian fauna is in danger of complete extinction, even before it has been adequately surveyed.

In the hope of arousing a public sense of responsibility in Australia, Mr. Finlayson has written a description of the topographical features and the most distinctive forms of the Mammalia to be found in these desert lands. In order that these mammals may be preserved, he suggests that that part of the central area which is now an aboriginal reserve should be declared a national park. As honorary curator of mammals of the South Australian Museum and a close student of



the fauna of the central area—he rediscovered *Caloprymnus*, the Plain kangaroo rat, known previously from three specimens only, which were collected in 1843, and lost to sight since that date—Mr. Finlayson speaks with authority.

Nor are the claims to attention of that most important mammal, man, overlooked. Three chapters are devoted to the people known by the Arunta name of 'Loritja'. The author not only takes a sympathetic view of this people, but also gives them an excellent testimonial for intelligence, good temper and generosity, when in their native surroundings and conditions. This estimate of their character is based upon exceptional opportunities for impartial judgment, when the aborigines thought themselves free from observation and were engaged in their ordinary vocations. His view that the settlers' opinion of the aboriginal is not so entirely adverse as its public expression would convey is probably correct. It is clear at any rate that public opinion is growing slowly in the direction indicated by Mr. Finlayson, who holds that a debt is due to the aboriginal, which must be discharged.

(3) The Misses Durack, members of a family which in 1881 first introduced cattle ranching in the Kimberley district of Western Australia, have jointly produced a book, the one providing the letterpress, the other the illustrations, which describes the aborigines, male and female, who work on the ranch and about the house at Argyle Station. It is an entertaining and valuable psychological study, which at the same time affords an instructive picture of the somewhat remarkable relations between employers and employed. The authors have succeeded in conveying vividly to the reader the aloofness of the blackfellow from the white, even after a long and intimate association, and the completeness of the reversion of the aborigines to the wild state, when they take their 'holiday'.

In these three books, it will be seen, three different views of the aboriginal are presented, which concur, notwithstanding differences of conditions, in ascribing to him some excellences, while taking a lenient view of characteristics and qualities for which he has been condemned. All alike will help to fuller understanding.

## Foundations of the New Geography

### (1) Elements of Geography

By Prof. Vernor C. Finch and Prof. Glenn T. Trewartha. (McGraw-Hill Series in Geography.) Pp. x+782. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 24s.

### (2) Geography:

an Introduction to Human Ecology. By Prof. C. Langdon White and Dr. George T. Renner. (Century Earth Science Series.) Pp. x+790. (New York and London: D. Appleton-Century Co., Inc., 1936.) 16s. net.

THERE is a certain ruthless analysis, a pitiless perfection of detail as it were, about American scientific writings which leaves the reviewer a little breathless. This is well illustrated in the two works now before us. They are almost too thorough. Every *i* is dotted, every *t* crossed; it is the *dernier cri* in university geography. This complete presentation of the subject, so typically American, is nevertheless invaluable to the student. If not exactly inspiring, it is at any rate challenging, which is better. "That," say the authors in effect, "is everything known on the subject. Can you get beyond it?" If the student is content to play for safety, he can come to no harm; but equipped so thoroughly for the fray, the pioneer mind will

presently find the weakest link in the iron chain of fact, and push outwards into new fields of learning.

These two books aim successfully at a compact presentation of the groundwork of geography, and supplement one another. The new geography recognizes that the study of land forms has no meaning except in relation to the earth's inhabitants, the ultimate stuff of geography. But the science of land forms, and of the elements which shape them, is essential to an understanding of human environment, which is an aspect of geography too often stressed by people who have no very clear understanding of what human environment is.

(1) Profs. Finch and Trewartha describe in detail the natural elements which affect or produce land forms, the climates and their distribution, and the land forms themselves. In Part 2 of their work the cultural elements of the landscape are described in 30 pages, as against more than 500 pages for the natural elements. Part 3 is devoted to a short description of the geographical *realms*, combining the features already described into a geographical unit.

This method of analysis followed by synthesis is useful, although the correlation between the



elements and the finished product might have been carried further. Thus nothing is said of mountain regions in the humid tropical realm, and of the conserving role of the forest covering. In fact, the synthetic portion suffers from over-compression. However, the student should be able to apply what he has learnt in the earlier chapters to any natural region in the world. The book can be recommended to university students.

(2) Prof. Langdon White and Dr. Renner begin where Profs. Finch and Trewartha leave off. The latter incline to the traditional view that geography is the science of land forms, and rather evade the question of what use land forms are—even as an intellectual exercise—apart from the human relationship. The former start with geography as a study of environment, and boldly assert the belief

of the neo-geographers, that the human relationship concept is the only justification for geography's existence. They assume a knowledge of the elements which make up the landscape, and plunge at once *in medias res* by describing the climatic realms. These are analysed on the basis of the geographical elements, and are followed by a description of the four principal habitats, similarly treated.

Only at the very end of the book, however, do we find a brief account of man as a serious factor in geography. Considering that the whole book aims at describing man's adjustment to, and activities in, his environment, the last chapter might well have been amplified and put at the beginning. The book is both readable and informative, and lavishly illustrated. It should stimulate students to ponder on the great geographical problems of the near future.

## Quantum Theory and Physical Problems

### Anschauliche Quantentheorie:

eine Einführung in die moderne Auffassung der Quantenerscheinungen. Von Prof. Dr. Pascual Jordan. Pp. xii+320. (Berlin: Julius Springer, 1936.) 13.80 gold marks.

POSSIBLY the description *anschaulich* in the title of Dr. Jordan's book may tend to deter some enthusiasts for quantum theoretical matters from reading it; since it may be claimed that only macroscopic conceptions can make physical theories *anschaulich* and it is just these which the quantum theory throws overboard. On the other hand, such a description is likely to attract those who, while having no great interest in the quantum theory itself, find themselves forced to know something about its pronouncements on various physical problems.

Of course the attribute of *Anschaulichkeit* belongs rather to the description of the empirical material out of which the theory has emerged and especially to Bohr's correspondence principle which, if a paradox may be permitted, is the most important contribution to the quantum theory and yet no part of it at all. It is the one great and indispensable guide in its development. Though perhaps Dr. Jordan (and even Bohr himself) would insist that the correspondence principle is not merely a heuristic device but an organic part of the quantum theory. Indeed such a claim may possibly be consistent with the 'positivistic' outlook of the author and of many other theoretical physicists, especially in Germany.

The book contains a quite admirable presentation of the main features of the quantum theory written by one of the great contributors to it. The importance of a thorough grasp of classical physical theory for a proper appreciation of quantum dynamics is very rightly emphasized in the very beginning of the book. The former indeed emerges from the latter in the limit  $\hbar \rightarrow 0$ . The early chapters deal with the fundamental experimental deliverances which have given birth to the quantum theory, and with their theoretical analysis. Then follows an account of quantum and wave mechanics with a simple proof of the equivalence of the two chief methods of the quantum theory, namely, that of Heisenberg with its matrix schemes and that of Schrödinger with its proper functions and associated proper values.

The part of the book which follows this deals with 'many-body' problems, with Fermi and Bose statistics, relativistic wave equations, nuclear structure and associated things. Here the author has been forced to squeeze a vast amount of material into too small a space with a consequent lack of clarity. Indeed the whole work is rather condensed and therefore more difficult to read than it might otherwise have been. In particular, the description of Dirac's electron theory is obscure. The author might have given a much better justification for equation (15) on p. 208 than the rather feeble statement that the generalization of the non-relativistic Schrödinger equation can only have the form (15). One wants to know the origin



of the  $\hbar \delta / 2\pi i \delta x - e \varphi / c$  which is so prominent in the equation. And why are there only four of the matrices  $\alpha$ ? Why not another matrix  $\alpha$  in front of  $\mu c$  instead of  $\sqrt{-1}$  in (23) on p. 210?

The latter part of the book has a distinctly philosophical character. It deals with the positivistic method, causality statistics and finality and the structure of the real world. No doubt the name positivism is applied to the philosophy of Mach and his disciples because of its resemblance to the philosophy of Comte; but its most distinctive features are *negative*. It is nearly always *rejecting*, and in the microphysical world it rejects

the causality which has dominated science until the present day.

The main epistemological principle of positivism seems to be that which permits only those statements to have a meaning which can be confirmed or denied by the outcome of some actual or conceivable experiment. It has at least one success to its credit. It rejected the ether and thus facilitated the development of the theory of relativity. Many of us, however, will doubt whether this principle is a safe guide, and will prefer the philosophical outlook of Planck, to whose genius and intuition the quantum theory is due.

W. W.

## Structure and Activities of Protoplasm

### Protoplasm

By Prof. William Seifriz. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. x + 584. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 36s.

**B**ROADLY speaking, there are in the field to-day three views of the constitution of protoplasm. While all are agreed that protoplasm is essentially a colloidal system, these views differ as to the kind of colloidal system which constitutes the living substance. According to one opinion, protoplasm is a liquid with a low viscosity and the general properties of a suspensoid or lyphobe system; according to another view, protoplasm is much more viscous and possesses rather the properties of a multiphase emulsoid or lyophile colloidal system; while the third view lays emphasis on its elastic properties which bring it rather into the category of gels. The chief exponents of the first two views, Profs. Heilbrunn and Lipeschkin, have already published books dealing with protoplasm and expounding their particular points of view. With the publication of a work on protoplasm by Prof. Seifriz, we have now a reasoned account of the subject by the chief exponent of the third view, which may be summed up in the words of the author: "Though often fluid, and though superficially an emulsion, protoplasm is primarily and fundamentally a lyophilic colloidal system, that is to say, a jelly".

The writer of a book with the simple title "Protoplasm", unlimited by any particular aspect of the subject, has to decide two main points with regard to the scope of the book. One of these is how much knowledge of physics and chemistry his readers may be assumed to possess, the other is how much of what are called cytology and

general physiology of the cell should be included. Actually quite a large proportion of Prof. Seifriz's book is devoted to a discussion of certain aspects of physics and chemistry, no less than 17 of the 27 chapters having physical or chemical titles such as "The Colloidal State", "Adsorption", "Viscosity", and it is a question whether most readers of a book of this kind would not already be acquainted with much of the physical and chemical information provided. Certainly most students in England who would want to read this book would have a general knowledge of the properties of colloidal systems, carbohydrates, fats and proteins, and know the meaning of the terms normal solution, electrolytic dissociation, hydrogen ion concentration and pH. It seems to the reviewer that all these matters are now so adequately dealt with and accessible in text-books of various branches of chemistry that a book with the title of "Protoplasm" is unnecessarily overloaded with such material when it reaches the proportions it does in the volume under review.

To a less extent the same criticism can be levelled against the book with regard to the quantity of material contained in it which deals with the physiological properties and behaviour of the cell. Thus there are chapters entitled "Permeability", "Electrophysiology" and "Regulatory Substances" (that is, hormones and vitamins), matters which are regarded as part of the province of physiology. Of course, it is quite logical to take the view that the study of protoplasm includes that of its activities, and that on these depend almost the whole of the physiological behaviour of the organism. Indeed, on p. 42, the author writes, at the end of a chapter on cytology: "Such are cells; with these and the matter that



fills them does this book deal". All the same, the subject of cell structure is generally called 'cytology' and that of cell behaviour 'cell physiology'. Moreover, it is not clear why, if a treatise on protoplasm is to have such a wide scope, some aspects of cell physiology, such as those mentioned above, are included, while others, such as respiration, a universal property of living matter, are excluded.

What, then, of protoplasm itself? The chapters dealing definitely with the subject of the book are the first ("The Living Substance"), the fourth and fifth on "Micurgy" and "Tissue Culture" respectively, and the fifteenth ("The Structure of Protoplasm and Organic Colloidal Matter"). There are also throughout the book, even in chapters purporting to deal with chemical and physical subjects, constant references to the bearing on protoplasm of the subjects discussed. To the reviewer, the chapter on the structure of protoplasm is the most interesting in the book, for in this the author presents his reasons for regarding protoplasm as possessing a fibrillar structure; reasons, the forcefulness of which readers must judge for themselves, but which the reviewer must confess he does not find particularly convincing.

The reviewer is mystified by the arrangement of the material in the book; why, for example, the chapters on carbohydrates, fats and proteins follow,

instead of precede, the chapter dealing with the structure of protoplasm.

All the same, if the contents of the book do not fit the title, and if they are strangely arranged, they do comprise much valuable and interesting material. The author states in his preface that the book is written for students of biology and medicine and the related fields of biophysics and biochemistry. Actually, as already indicated, it contains among other material, accounts of physical and chemical principles with which students of physiology should be acquainted, and as such can be recommended to those who require a text-book bringing together necessary information on these matters. The reviewer, however, cannot help feeling that Prof. Seifriz would have rendered much greater assistance to students of biology if, instead of bringing together the materials he has into one book, he had divided it and written two books, one comprising an exposition of the fundamental physical and chemical principles necessary for an understanding of physiological processes, the other a work more strictly confined to an account of protoplasm. The latter might well have included not only a detailed statement of his own views of the structure of the living substance, but also a reasoned criticism of other views of the constitution of protoplasm with which he may not be in agreement.

## Bird Migration

### Bird Migration:

a Short Account. By Dr. A. Landsborough Thomson. (Birdlovers' Manuals.) Pp. 224 +6 plates. (London: H. F. and G. Witherby, 1936.) 5s. net.

AN account of a subject with as many ramifications as bird migration can be handled in different ways. Dr. Landsborough Thomson has chosen to present the subject from the impartial point of view of a well-informed spectator. He has neither pet theories to develop nor a personal axe to grind. His treatment is comprehensive in spite of rather severe space limitations, and the vast array of facts is systematically marshalled and logically presented.

The book is quite general and deals with migration in the widest sense. Specific examples of migratory behaviour are not too freely used and are drawn in the main from British sources. Authors are sparingly cited and there is no bibliography. Readers interested in more particular knowledge are referred to a short list of suitably selected works.

The make-up of the book is attractive and its few illustrations are unusually well reproduced.

Occasional inaccuracies occur, as in the description of the migrations of the American golden plover. The statement that the spring passage is through the interior of the continent and the autumn passage over the Atlantic from Newfoundland to the Lesser Antilles is only partly correct. Actually it is only the adults that use the latter route in the autumn, while the immature birds proceed south separately through the interior, generally at a later date. It would be nice to see this classical but incorrect account dropped permanently from migration literature, particularly in a book with the merits of this one. The author appears to be over-cautious in his treatment of modern investigations. Even if their final implications are as yet open to doubt, they should at least be mentioned if there is no space to accord them a brief description.

It seems regrettable that interest in bird migration should be largely confined to ornithologists. The present volume, short but dependable and eminently readable, contains much food for thought for the general biologist. WM. ROWAN.



**Handbuch der Astrophysik**

Herausgegeben von G. Eberhard, A. Kohlschütter, H. Ludendorff. Band 7: Ergänzungsband, Berücksichtigend die Literatur bis Ende 1934, nebst einem Generalregister des Gesamtwerkes. Pp. ix+756. (Berlin: Julius Springer, 1936.) 129 gold marks.

THE previous volumes of this "Handbook" came out during the course of the years 1928-33. As the articles were mostly undated, the general effect was ragged. This supplementary volume serves three purposes. It gives a common date, the end of 1934, up to which the literature of the separate branches has been considered by the writers of the articles, it covers the recent developments of the subject-matter and it fills gaps in the earlier discussions.

The same subdivisions of each chapter are followed as in the earlier volumes, new items being indicated by placing letters *a, b, c*, after the number of a paragraph. The practice of different contributors in distinguishing new topics from additional or supplementary material has varied; still, the affixed letters do direct attention to the most recent developments in the subject. It is significant that in the section on photometry there are 48 new paragraphs and only 18 supplementary ones. In this section there is no reference to recent work on the profiles and central intensities of spectral lines; these are only referred to in the appropriate sections dealing with the sun and the stars, but in view of the amount of work done since 1929, one would have expected some notes in the section on spectral photometry.

It is impossible to mention all the thirty articles in a short notice, but we can note in that by Dr. Wurm on band spectra an interesting new section on astrophysical applications. In two articles, on the "Thermodynamics of the Stars and Pulsation Theory" and on "The Ionization in the Atmospheres of Celestial Bodies", Dr. Bengt Strömgren has given a full account of recent work on stellar interiors and radiation, having to blend in his treatment references to the articles of Prof. Milne and Prof. Pannekoek in the earlier volumes.

In rounding off various topics and in giving a combined subject-index, this supplementary volume adds appreciably to the value of the earlier parts of the "Handbook", and the editors are to be congratulated on bringing a long and arduous task to a worthy conclusion.

**The Earth's Magnetism**

By Prof. S. Chapman. (Methuen's Monographs on Physical Subjects.) Pp. xi+116. (London: Methuen and Co., Ltd., 1936.) 3s. 6d. net.

THE phenomena comprised under the general head "Terrestrial Magnetism" are important, and their explanation is still far from complete. A concise account of present knowledge of the subject was needed. From the hand of one who himself has contributed largely to recent advances such an account is doubly welcome.

In his small monograph, "The Earth's Magnetism", Prof. Chapman has attempted at least to touch upon all material points, leaving amplification of details

and theory to a more extended treatise which is already planned. A relatively large amount of information is given, however, about effects of solar and even of lunar origin, the existence of which has been demonstrated by laborious statistical treatment of observatory records and could not otherwise be revealed. The inclusion of a number of illustrative diagrams is helpful in this section. The author's terse and graphic style matches the compact form in which the subject is presented. Readers will find themselves carried on from page to page with absorbing interest.

A few typographical errors in formulæ await correction in subsequent editions; while the method of measuring horizontal force by the Schuster-Smith coil-magnetometer, described on page 7, should be restated, as it differs in a fundamental particular from the method actually proposed by Schuster and employed in the instrument. W. M. W.

**Annual Survey of American Chemistry**

Vol. 10, 1935. Edited by Clarence J. West. (Published for the National Research Council.) Pp. 487. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1936.) 25s. net.

THIS volume presents an interesting view of the progress made in certain branches of pure and applied chemistry in the United States during 1935. The fact, however, that it deals only with the work of one nation, limits its usefulness as a guide to the advancement made in any particular subject, and leads perhaps to a somewhat distorted view. Nevertheless, it provides an excellent résumé of the activities of American chemists, and moreover supplies a comprehensive bibliography of their work.

The subject matter is divided into twenty-five chapters, each compiled by an expert in the topic under review. For the most part, these are well written, interesting and readable, even although the space available necessitates considerable compression and permits of only a brief summary of the many contributions made in each section. Thirteen of the chapters deal with pure chemistry while the remainder are devoted to industrial chemistry. Included in the latter is a chapter on chemical economics which, like one or two other sections, covers a longer period than one year. G. R. D.

**The Little Wolf:**

a Story of the Coyote of the Rocky Mountains. By Wendell and Lucie Chapman. Pp. xii+140+31 plates. (London: Charles Scribner's Sons, Ltd., 1936.) 6s. net.

No one can have travelled in the western States of America without having become more or less acquainted with the coyote. But whether one has done so or not makes little difference to the enjoyment of this book, which is a true piece of nature study at its best. The authors have spent years in the uninhabited sections of the western part of the United States and Canada, and have been able to make friends with the shyest of wild creatures, observing them at work and play, and finally enlisting the help of the camera. Both the story and the illustrations are excellent.



# Theory of Complex Atoms\*

## INTRODUCTION

THE structure of complex atoms forms one of the main fields of application of quantum mechanics to many-body problems. The subject has two main aspects: the outer electronic structure, taking the nucleus as a point charge; and the structure of the nucleus.

In considering the outer electronic structure in non-relativistic approximation, which is sufficient for evaluating the main features of the structure of all but the heavy atoms, the forces involved are known, so that an exact wave equation can be written down, and the only difficulty, though a formidable one, is to obtain a solution of it. In the relativistic treatment of the electronic structure, there is the additional difficulty that the exact interaction between two electrons is as yet unknown, so that no exact wave equation can be written down; whereas in the nucleus the quantitative behaviour of the forces concerned are almost entirely unknown, and even their nature is still uncertain.

## QUANTITATIVE EVALUATION OF ATOMIC STRUCTURES IN NON-RELATIVISTIC APPROXIMATION

The calculation of atomic properties usually involves a knowledge of the atomic wave functions, and the first step is therefore the evaluation of such wave functions; no exact solution of the wave equation of a many-electron atom is known, and one has to be content with an approximation.

The 'solar system' type of approximation, in which the mutual interactions of the electrons are first neglected, and later introduced as a perturbation, is too crude to give significant quantitative results.

A simple type of approximation is to reduce the many-body problem to a set of one-body problems by regarding each electron as being in the field of the nucleus and some average of the field of the other electrons. This type of approximation had already been found to be qualitatively, and roughly quantitatively, successful in the days of the old quantum theory; wave mechanics made it possible to apply it much more precisely, and led Hartree<sup>1</sup> to the idea of the 'self-consistent field', in which each electron is considered to

occupy a definite wave function in the field of the nucleus and of the average distribution of charge of the other electrons. In so far as the description of the structure of an atom in terms of occupied one-electron wave functions is significant at all, the electrons cannot really be ascribed each to a specific one of the wave functions, but account should be taken of the possible exchange of electrons between them in obtaining the average field of each electron; this improvement was carried out by Fock<sup>2</sup>.

The solutions of the differential equations of the self-consistent field, either with or without exchange, have to be evaluated by numerical integration. Solutions of the equations without exchange have been carried out for a number of representative atoms up to mercury; the solution of the equations with exchange presents a much more formidable problem of numerical technique, but has been carried out for several atoms up to copper.

Another, more analytical, approach to the determination of approximate wave functions is provided by the variation principle, which also provides a criterion for comparing two approximations, without knowing the exact wave function. This principle states that the value of a certain integral expression, involving an arbitrary function, is an absolute minimum when evaluated for the wave function of the normal state, and has certain minimal properties for that of any excited state. It can be applied to the determination of the best approximation of any particular form to the wave function of an atom in two ways.

One way is to take for the whole atom a wave function constructed in a definite way out of adjustable *functions* of the variables of the system; the variation principle then leads to differential equations for the unknown functions. This method was used by Fock<sup>2</sup> to derive the equations of the self-consistent field with exchange, and shows that the solutions of these equations provide the best possible wave functions for the whole atom that can be obtained, so long as the structure is regarded as consisting of a number of one-electron wave functions each occupied by an electron.

The other way is to limit the functions to specified analytical forms (usually sums of products of exponentials and polynomials), with adjustable *parameters* whose best values are determined by the appeal to the variation principle. This method has been used by Zener<sup>3</sup> and others<sup>4</sup> to obtain

\* A review of a group of papers by Prof. D. R. Hartree, F.R.S., Dr. B. Swirles and Dr. H. S. W. Massey, read to Section A (Department of Mathematics) of the British Association at Blackpool on September 14.



analytical wave functions for the light atom (up to 10 electrons); it has the advantage that the inclusion of exchange terms presents no difficulty, and the disadvantage that the number of parameters required to give a good approximation is rather large, and the simultaneous determination of their best values is difficult and laborious. It has also been used by Hylleraas<sup>5</sup> to find better approximations to the wave function of two-electron systems than can be obtained by regarding the structure as consisting of the two occupied one-electron wave functions. The calculation of the ionization energy of helium was one of the points at which the old quantum theory failed, and it is of some importance that the best approximate wave function obtained by Hylleraas gave an energy value in very close agreement with experiment, thus justifying the form of the wave equation adopted in the application of wave mechanics to many-body systems. This work has recently been extended to lithium by James and Coolidge<sup>6</sup>.

#### RELATIVISTIC TREATMENT OF THE OUTER ELECTRONIC STRUCTURE

The idea of the self-consistent field, without or with exchange, is still applicable when the one-electron wave functions are taken to satisfy Dirac's equation, instead of Schrödinger's, in the field of the nucleus and an average of the field of the electrons in the other wave functions; also the variation principle is still applicable. It has been used recently by Swirles<sup>7</sup> to obtain the equations with exchange.

Relativistic effects are of order  $1/c^2$  (where  $c = 137$ , the measure of the velocity of light in atomic units), and since retardation effects and interactions between electron spins give contributions to the Hamiltonians of this order, they should be included. It is not yet known how to do this exactly, but it can be done to an approximation which is probably as good as that of the self-consistent field<sup>7</sup>.

#### STRUCTURE OF THE NUCLEUS

For the outer electronic structure, the forces involved are known (at least very closely), and wave mechanics is applied to deduce the structure and properties of the atom. For the nucleus, the problem is the inverse one of determining the forces, if possible, from those properties of the solutions of the wave equation which represent observed phenomena; this can only be done by trial and error, and it is possible that quantitative determination may not be unique.

There are two main phenomena, the nuclear binding energies as deduced from mass defects, and mean free paths and angular distribution of scattered particles for collisions between nuclear particles. A general conclusion is that the forces involved (other than the Coulomb force between two charges) are short-range, and this has a qualitative result that the number of stationary states may be finite, and perhaps quite small, in contrast to the infinite number in a Coulomb field.

Taking the nucleus as built up of protons and neutrons, as first suggested by Heisenberg<sup>8</sup>, there are three forces to consider: those between neutron and neutron, between proton and proton, and between neutron and proton. Of these the last is the most important, as shown by the fact that the most stable nuclei are those with equal numbers of neutrons and protons. These forces cannot be simple attractive forces derivable from potentials, since, if they were, the total binding energy would be proportional to the square of the number of the particles, whereas it is in fact proportional to the number itself. One possible explanation is that the forces change sign and become repulsive at very short distances, and another is that the neutron-proton interaction is analogous to the 'exchange' interaction between two hydrogen atoms, to which, in the Heitler-London approximation, their binding into a molecule is ascribed. Such an interaction might be pictured as an exchange of charge between the two particles, so that sometimes one is a proton and the other a neutron and vice versa.

If this exchange of charge were accompanied by exchange of spins, as suggested by Heisenberg<sup>8</sup>, the exchange force would lead to saturation effects such that each proton would only interact with one neutron at a time; but if no exchange of spins took place, as suggested by Majorana<sup>9</sup>, the saturation effects would be such that each proton would interact with all those neutrons in the same orbital quantum state, and only those. The fact that the simplest saturated structure is the  $\alpha$ -particle and not the deuteron indicates that the type of force suggested by Majorana predominates in the neutron-proton interaction. However, more detailed evidence, provided by the properties of the deuteron and by neutron-proton collisions, though incomplete, is enough to show that a force of this kind alone will not account quantitatively for all the observed phenomena.

Evidence of proton-proton and neutron-neutron forces<sup>10</sup> is provided by collisions between protons, which show that the Coulomb force does not hold for very small distances, and by the mass defects of  $^3\text{H}$  (2 neutrons, 1 proton),  $^3\text{He}$  (1 neutron, 2 protons) and  $^4\text{He}$  (2 neutrons, 2 protons).



The short ranges of the forces between nuclear particles, and their large magnitudes at short range, make a satisfactory solution of the wave equation, and calculation of the binding energy, very difficult. The type of approximation used in the self-consistent field for the outer electronic structure is probably not good enough to be significant, and even in this approximation, the behaviour of the solution is inconveniently sensitive to the detailed behaviour of the function specifying the interaction. Hence the quantitative treatment

of nuclear structures is likely to be much more difficult than that of the outer electronic structure.

D. R. H.

<sup>1</sup> D. R. Hartree, *Proc. Camb. Phil. Soc.*, **24**, 89 (1928); see also *Proc. Roy. Soc., A*, **141**, 282 (1933).

<sup>2</sup> V. Fock, *Z. Phys.*, **61**, 126 (1930).

<sup>3</sup> C. Zener, *Phys. Rev.*, **36**, 51 (1930).

<sup>4</sup> See particularly P. M. Morse and others, *Phys. Rev.*, **48**, 948 (1935).

<sup>5</sup> E. Hylleraas, *Z. Phys.*, **54**, 347 (1929).

<sup>6</sup> H. M. James and A. S. Coolidge, *Phys. Rev.*, **49**, 688 (1936).

<sup>7</sup> B. Swirles, *Proc. Roy. Soc., A*, **152**, 625 (1935), and a paper in press.

<sup>8</sup> W. Heisenberg, *Z. Phys.*, **77**, 1 (1932).

<sup>9</sup> E. Majorana, *Z. Phys.*, **82**, 137 (1933).

<sup>10</sup> L. H. Thomas, *Phys. Rev.*, **47**, 903 (1935); H. S. W. Massey and C. B. O. Mohr, *Proc. Roy. Soc., A*, **152**, 693 (1935) and **156**, 634 (1936); E. Feenberg, *Phys. Rev.*, **48**, 907 (1935) and others in *Phys. Rev.*

## A New Fossil Skull from Eyassi, East Africa

DISCOVERY BY A GERMAN EXPEDITION

By Dr. L. S. B. Leakey

IN the course of a scientific expedition to the Eyassi Lake basin in Tanganyika Territory in 1934-36, Dr. Kohl-Larsen had the good fortune to discover parts of three fossil human skulls in association with stone artefacts and fossil mammalian remains, and in July of this year, after the material had been unpacked at the Natural History Museum in Berlin, I was allowed the privilege of spending a week examining them in the Department of Geology there.

Through the kindness of Dr. Kohl-Larsen and Prof. H. Reck, I am now able to publish this preliminary note on the impressions gained during that week, and I would like to take this opportunity of thanking them publicly for allowing me to examine the material and to publish this note. Two short preliminary notes have already been published by Dr. Kohl-Larsen in *Forschungen und Fortschritte* (Berlin) in the August I and September I numbers, and a further note is being published in the November number of the *Geologische Rundschau*<sup>1</sup>.

Of the three skulls mentioned above, two are represented by one small fragment each, and will not be discussed in this note. The third skull is represented by a very large number of pieces, many of which fit together perfectly, so that a reasonable reconstruction of part of the skull is possible.

The find was made at the north-east end of Lake Eyassi, and the deposit which contained the skull fragments, artefacts and associated mammalian fossils was exposed on the floor of the present lake basin as a result of the recession of the waters during the dry season. Three distinct strata were noted by Dr. Kohl-Larsen, and the material to be discussed came from the middle

one, which was reddish in colour and perhaps represents an old land-surface. The strata both above and below it contained numerous fish remains.

During my stay in Berlin, Prof. Reck and I jointly examined the fossil fauna, the artefacts and the skull itself, in that order, and our preliminary conclusions are as follows.

### THE ASSOCIATED FAUNA

The animal remains are very considerably broken up and are all heavily mineralized and of a blackish colour. The majority of the bones and teeth are unrolled, but a few heavily rolled teeth and bones were included.

Taking the rolled fauna first. This was found to include a few teeth of *Hipparion*, a few teeth of a baboon, apparently of the *Simopithecus* type, and some teeth of a large giraffid, all of which occur in the fauna of the Middle Pleistocene at Oldoway and other East African sites. These fossils appear to be derived from an older deposit than that in which they were found.

The unrolled fauna, which was much more plentiful, did not appear to contain any extinct species (so far as a superficial examination showed), with the exception of a bovid of the *Bubalus* type, an antelope and a large carnivore. The latter is represented by a part of a mandible which is slightly rolled and may belong to the derived fauna. The remaining species include bones and teeth representing zebra, giraffe, pig and wart-hog, hippopotamus, rhinoceros (both black and white), baboon, small monkey, porcupine and small rodents.



The general impression created by the fauna is that it represents the Upper Pleistocene period (Gamblian Pluvial period). In Kenya the fauna of the Gamblian Pluvial is known to consist mainly of living species with a few extinct ones, among which is *Bos bubalus*, and an extinct antelope. The presence of rolled teeth and bones of the older fauna cannot be used for dating this deposit because they are obviously derived fossils. Prof. Detreich has examined the fauna since I left Berlin, and has confirmed the views expressed above.

CULTURE OF THE REMAINS

Associated with the fauna described above was a large series of stone artefacts, the majority of which are unrolled and of apparently the same date as the unrolled fauna. Careful examination of every specimen showed that the culture was essentially of Levalloisian type. There are many 'tortoise cores', some of them having had Levallois-type flakes struck from them and some of them having been prepared but unstruck. With these cores are large numbers of absolutely characteristic Levallois flakes with faceted striking platforms. Only two or three pieces, however, show any signs of secondary retouch.

Compared with Levallois material from elsewhere in East Africa, my own impression is that the assemblage represents a stage of development similar to that which occurs in deposits which can be dated to the early and middle part of the Gamblian Pluvial period. The evidence of the culture thus corroborates the Gamblian age suggested by the fauna.

Associated with the Levallois assemblage were a very few broken Acheulean hand-axes, as well as many lumps of lava. Personally, I am inclined to regard these few broken hand-axes as having been picked up and brought to the site with the rough blocks of lava as raw material for making the artefacts of Levalloisian type.

THE SKULL

The skull, which is unrolled, and in exactly the same state of fossilization as the unrolled faunal remains described above, was represented by numerous fragments, and before it was possible to examine it, Prof. Reck had to fit the pieces together so far as possible. It was my good fortune to assist in this task; many of the fragments fitted perfectly, and when fitted together they were found to represent:

- (a) the greater part of the left parietal;
- (b) the greater part of the occipital;

- (c) the greater part of the left temporal including the mastoid and petrous portions.

In addition, several further fragments fitted together to form a part of the frontal bone, with which were associated two fragments from the supraorbital region; these, however, *did not have any direct points of contact* with the rest of the broken frontal. On the other hand, the occipital, left parietal and left temporal bones fortunately articulated perfectly along the sutures, so that their relation to each other was clear. All the bones are very thick compared with the comparable parts of a modern skull. Figs. 1 and 2 show the result

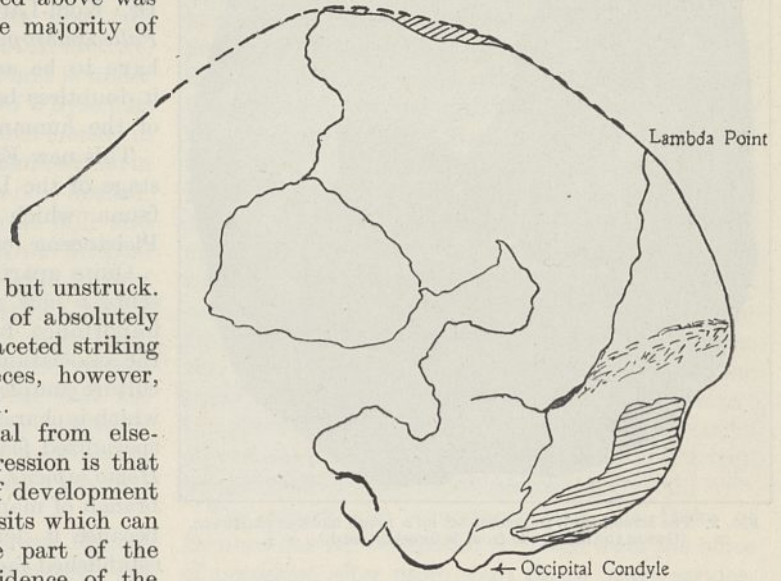


FIG. 1. Profile drawing of the Eyassi skull, based upon photographs.  $\times \frac{1}{4}$ .

of the preliminary reconstruction, which may be regarded as reasonably accurate so far as these three portions of the skull are concerned, owing to the fact of articulation along the suture lines.

The skull presents certain remarkable features. First, the *foramen magnum*, part of which is fortunately preserved, is inclined backwards at an angle comparable to that found in the great apes and quite unlike any *Homo*. Secondly, when viewed from the back, the greatest width of the skull is seen to be in the region of the mastoids, and the form is thus one which approaches that found in *Sinanthropus Pekinensis* rather than any other known human skull. Thirdly, the external occipital crest is very strongly marked, but is smooth and rounded in form. Unfortunately, the fragments of frontal bone which fit together do not have any point of contact with the parietal, so that their exact relationship to the rest of the skull can only be guessed. What is, however, important is that the fragments of supra-orbital show clearly that



the skull had a torus (Fig. 3) not unlike that in *Sinanthropus*. One of the fragments is from the region of the glabella and the other from the right external orbital angle.

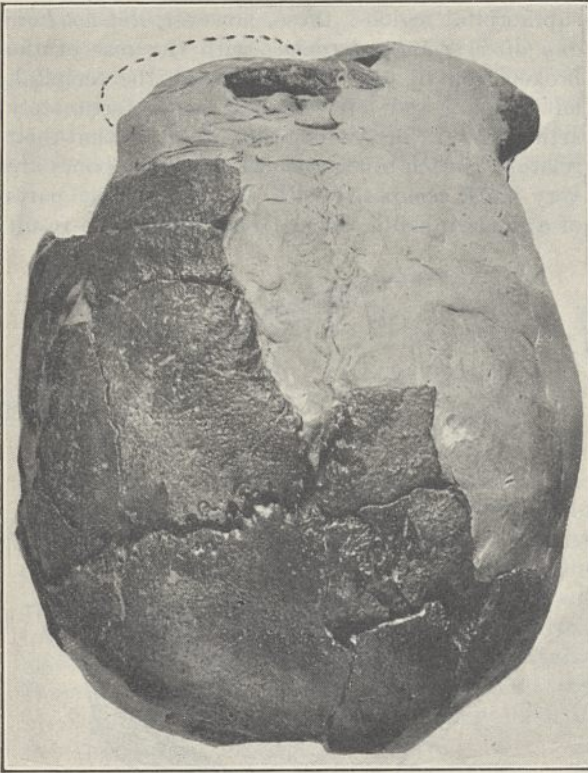


FIG. 2. The Eyassi skull fragments set on a rough block of plasticine. (Owing to tilting, the front is foreshortened.)  $\times \frac{1}{2}$ .

In addition to the parts already mentioned, there is a fragment of the left maxilla which contains the broken sockets of the two incisors, the left canine and first premolar teeth, and the broken socket of the second premolar. There is also a loose upper (first ?) molar of which the roots are somewhat damaged. (It should be pointed out here that in the illustrations published in *Forschungen und Fortschritte* of September 1, this molar tooth is shown in the position of the second premolar, having been mistakenly fitted into the broken socket of that tooth.)

The teeth are well worn and have several remarkable characters, but all that need be said at present is that the canine is of human rather than anthropoid proportions and form, and that there seems to have been no diastema between it and the incisors.

One other small fragment, which does not, unfortunately, fit on to the major portions of the skull, deserves special mention. This is a part of the tympanic plate from the right side (that on the left side is broken away although the rest of the left temporal bone is more or less complete) which is remarkably like that of a chimpanzee,

and quite unlike the form found in *Sinanthropus* or, so far as I know, in any *Homo*.

#### SUMMARY OF PRELIMINARY CONCLUSIONS

Dr. Kohl-Larsen has undoubtedly discovered an exceedingly interesting and very important new document relating to early man. The skull represents a low type of human with some markedly anthropoid characters (the angle at which the *foramen magnum* is set, and the nature of the tympanic plate, for example) while in other ways it approximates more to the type represented by *Sinanthropus* than to any other known human fossil. In a preliminary report by Prof. Reck and Dr. Kohl-Larsen, it is attributed to the genus *Palaeoanthropus*, but my own view is that it will have to be accorded new generic rank, although it doubtless belongs to the palaeoanthropid branch of the human stem.

This new East African skull is associated with a stage of the Levalloisian culture and with a fossil fauna which both strongly suggest an Upper Pleistocene (early or middle Gamblian) date.

Quite apart from the fact that the skull represents a new genus of man, it is of the greatest importance because it once again demonstrates the association of the great Levalloisian-Mousterian culture complex with that branch of the human stem which is characterized by a massive torus and other specialized features which are never found in any *Homo sapiens*, but are typical of the palaeoanthropid branch of man. It is also of particular importance because it demonstrates still further the already established fact that during the Pleistocene period (and even the Upper Pleistocene), the human family was represented in the world by a number

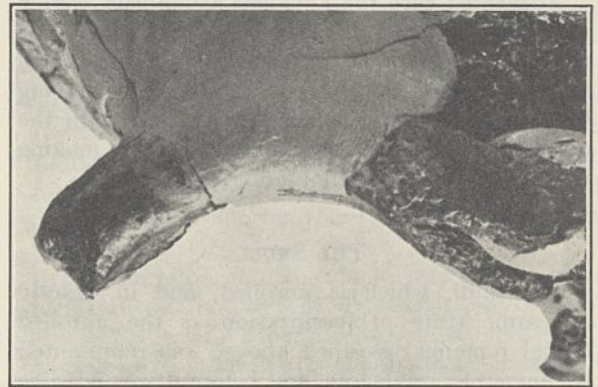


FIG. 3. Photograph showing the massive torus of the Eyassi skull.

of distinct genera and species, of which only one, *Homo sapiens*, has survived.

The detailed study of this skull will be awaited with the greatest interest.

<sup>1</sup> "Erster Ueberblick über die Jungdiluvialen Tier- und Menschenfunde Dr. Kohl-Larsen in Nordöstlichen teil des Njarasa-Grabens (Ost-Afrika) und die Geologischen Verhältnisse des Fundgebietes," *Geologische Rundschau*, Nov. 1936.



## The Imperial Cancer Research Fund

THE thirteenth report of the British Empire Cancer Campaign was dealt with in *NATURE* of December 12. We have now received the thirty-fourth annual report of the Imperial Cancer Research Fund\*. The Fund began in 1902, and its activities have been in the main devoted to the experimental study of cancer in its own laboratories; besides being one of the first, it has earned its position as one of the leading organizations for the study of malignant disease, and the high quality of the work done under its first two directors, Dr. E. F. Bashford and Dr. J. A. Murray, has been generally recognized. The Fund is under the direction of the Royal Colleges of Physicians and Surgeons, and it has until now been housed in their Examination Halls on the Embankment and in Queen Square, London; more room is now needed, and a new building is to be put up at Mill Hill with plenty of spare land leased from the Medical Research Council. When the cause and cure of cancer have been ascertained, the Royal Colleges will have the duty of diverting the endowment to some other line of medical research; meanwhile, there is no reason for supposing that the new director, Dr. W. E. Gye, and his assistants will not have their hands full with the multiplicity of work in various directions into which modern cancer research has developed.

The present report details sound progress, though Dr. Gye has nothing sensational to announce. He stresses the necessity of distinguishing between two categories of 'causes' of cancer which are sometimes confused. There is first the nature of the intrinsic cellular change which confers upon a cell the property of malignancy, that is, its dissociation from functional relationships with the rest of the body and its capacity for continuous and autonomous growth. The factor which produces this change resides in the cell, and cannot be attributed to external agents; it is the proximate cause of cancer and we know little about it, but seeing that in essential characters all malignant cells are alike, we may surmise that the nature of the change is always the same. It may, however, be preceded by a number of remote causes of diverse nature which bring about the fundamental intracellular change—radium, X-rays, many chemical substances, etc.—and of these we now have fairly extensive knowledge which, if it tells us little about the nature of malignancy, enables us on one hand to prevent some cancers in man, and on the other to produce fresh tumours in animals

for experimental study. Another general point brought out in several places in the report is the importance of constitution or diathesis, which comes out clearly now that more precise methods of starting tumours are available, and it seems that this concerns particular organs rather than the animal as a whole.

Much attention has naturally been paid to the virus tumours which can be transferred from one animal to another by cell-free extracts. Attempts to repeat McIntosh's observation that fowl tumours produced by chemicals could be transmitted by filtrates all failed, but it was found that such cell-free extracts injected into rabbits would, equally with tumour tissue, excite the appearance in the blood of a capacity to neutralize the virus of the Rous sarcoma. Since the same chemical (tar, dibenzanthracene, etc.) will induce tumours in mammals as well as birds, it seems likely that something like a virus can be evoked from all cancers. The whole question is at the moment extremely complicated. The effect of radium has also been further investigated, especially by the study of its action on various enzyme systems: it appears that radiation inhibits the utilization of carbohydrates by the cells, which are driven to get their energy from proteins.

The report also announces that the Duke of Bedford has felt compelled to resign from the office of president after more than thirty years service, and that he will be succeeded by Viscount Halifax.

SIR BASIL MAYHEW, vice-president, presiding at the general meeting of the Imperial Cancer Research Fund held on December 15, stated that the new building at Mill Hill will cost £20,000 and a further £10,000 will be required for equipment. The Fund has £11,000 in hand; it requires £19,000. Referring to the relationship of the British Empire Cancer Campaign to the Imperial Cancer Research Fund, he said that the latter has raised large sums, and its policy is to use them in endowing and supporting institutions and individuals engaged in research work. Many of those to whom such grants have been made by the British Empire Cancer Campaign have been supplied with scientific material by the Imperial Cancer Research Fund. By this means, investigators have been enabled to start on their researches at a stage far in advance of that otherwise possible. Advice and suggestions are given whenever asked, facilities are given for research workers to use the Fund's laboratories, and tests are undertaken of cancer 'cures'.

\* Thirty-fourth Annual Report 1935-1936 of the Imperial Cancer Research Fund. Pp. 44. (London: Imperial Cancer Research Fund, 1936.)



## Obituary

### Dr. W. Schmidt

THE news of the death on November 27 of Dr. Wilhelm Schmidt, the director of the Central Institute of Meteorology at Vienna, comes as a great blow to his friends and colleagues in meteorology and geophysics. Many of us had seen him recently at Edinburgh at the meeting of the International Union of Geodesy and Geophysics, quite recovered from his illness, keen and interested as always, full of energy and to all appearances with a long period of active scientific work still before him.

Wilhelm Schmidt was born on January 21, 1883. His forbears, as his name indicates, were smiths, in a village some 12 km. from Innsbruck. His grandfather, a man of great courage and determination, decided to go to the University at Innsbruck to study, and began to walk there and back every day, working in the smithy before he started and after he got back. Schmidt may be said to have inherited from him his determination and his capacity for work.

After an education at the University of Vienna, Schmidt entered the Central Institute for Meteorology and Magnetism and was appointed assistant in 1909. I first met him there at the beginning of 1909 when Trabert was director and Julius Hann, former director and editor of the *Meteorologisches Zeitschrift*, had his room at the Institute. Among Schmidt's colleagues in the Institute were Exner, Defant, Wagner, R. Schneider, Hanzlik and von Ficker—a notable company.

Schmidt's main interest at that time, as indeed in later years, lay in the study of the structure of the atmosphere. It was a time when the first fruits of the international investigation of the upper air were being gathered. He was anxious to test their basis and invited me to collaborate with him in finding the lag of the instruments which were being used. The result proved to our satisfaction that the stratosphere could not be explained away as due to lag in the instruments.

Shortly afterwards, Schmidt turned his attention to an examination of barometric waves of relatively short period, particularly in the neighbourhood of Innsbruck. He found that the waves agreed with the waves which would be expected at the boundary between two currents of different density and that observations of cloud confirmed his deductions. He gave an account of his experiments at the Sheffield meeting of the British Association in 1910.

During and after the Great War, Schmidt became specially interested in the phenomena of turbulence and worked on this subject at about the same time as G. I. Taylor was working on it in Great Britain. The results of his work he embodied later in a book entitled: "Der Massenaustausch in freier Luft und verwandte Erscheinungen". Schmidt attacked the problem of turbulence in a slightly different way from that adopted by Taylor. His development of

the theory was based on the assumption that an eddy carried with it (at least throughout the period of life in which it is of interest) the momentum with which it enters the field of observation. The quantity which he defined as *Austausch* is equal to the eddy viscosity multiplied by the density. The lead which Schmidt gave has been followed by other writers such as Prandtl and von Kármán.

In this as in other branches of meteorology, Schmidt always wanted to get behind the formulae and the mathematics to the underlying physical principles. This is illustrated by a remark of L. F. Richardson's about the independence of the coefficient of eddy diffusion of the quantity diffused: "This was explained by G. I. Taylor and later W. Schmidt gave the general notion behind any mathematical argument in the form that an exchange of mass goes on, and that the measure *c* will be the same for any properties which this mass simply carries with it."

In 1930 Schmidt was appointed editor of the *Meteorologische Zeitschrift* in collaboration with Süring, and under his editorship the *Zeitschrift* maintained its high position as the leading monthly meteorological journal of the world.

In 1924 Schmidt was appointed professor of meteorology at the Agricultural College at Vienna, and he became particularly interested in problems of local climatology. During this period and the period while he was director of the Institute after the death of Exner in 1930, he gave himself wholeheartedly to investigations in this subject. It was at a time when funds for scientific research were very difficult to secure in Vienna, but he managed to get some help from the Deutsche Notgemeinschaft and he fitted out a travelling observatory for investigating the practically simultaneous variations in conditions in different parts of Vienna and the neighbourhood. Later on, he extended these investigations of local climate and micro-climatology to some parts of the Austrian Alps, and he gave a lecture before the Royal Meteorological Society in March 1934 briefly describing this work. In the following year he described the results of his investigations of turbulence and of the flow of air in the neighbourhood of the ground in a paper read before the Royal Aeronautical Society.

Early in 1935, after the death of Prof. Wallen, Schmidt took charge of the International Commission for Agricultural Meteorology, of which he had been secretary, and he was elected president at the meeting of the Commission in Danzig in 1935. At the end of 1935 he was awarded the Symons Gold Medal of the Royal Meteorological Society, perhaps the highest meteorological award of any in the world. His most recent work was a book written in collaboration with Dr. Brezina on "Kunstliche Klima in der Umgebung des Menschen", a copy of which he sent to me with a friendly note on November 25, only two days before he died.



Schmidt loved the country and the mountains as he loved his work and intercourse with his colleagues. He was a great meteorologist and a lovable man. His loss will be keenly felt by all who knew him personally and by many who knew him only through his published work. It is a blow which falls particularly severely on Vienna, the more so coming as it does after the sudden and unexpected death of Exner six years ago.

E. GOLD.

### Prof. J. T. Cash, F.R.S.

JOHN THEODORE CASH, emeritus professor of materia medica and therapeutics in the University of Aberdeen, who died on November 30, was a man of wide sympathies and, to those fortunate to know him intimately, a delightful companion. Born in Manchester in 1854, he studied arts and medicine at Edinburgh, qualified as M.B., C.M. in 1876, and proceeded to M.D., his thesis for which earned a gold medal, in 1879. After qualification he worked and studied at Paris, Vienna, Berlin and Leipzig.

Cash's early interests were in physiology and hygiene, but later they became almost purely pharmacological. The post-Continental period he spent in London, and investigated the pharmacological action of organic lead compounds, the action of chemical disinfectants (which he reported to the Local Government Board), and contributed, with Lauder Brunton, an important paper on the connexion between chemical constitution and physiological action to the Royal Society. He was elected a fellow of the Royal Society in 1887.

The appointment of Cash to the chair of materia medica and therapeutics at Aberdeen in 1886 was a surprise, for the chair had previously been held by medical practitioners, and Theodore Cash was a pure researcher. The appointment was, however, fully justified. Although only a part-time job, he devoted himself wholly to university work. A student of his first class was Arthur Cushny, who became successively professor of pharmacology in the University of Michigan, in University College, London, and lastly professor of materia medica and therapeutics in the University of Edinburgh.

At Aberdeen, Cash continued his investigations on chemical constitution and physiological action, then on the action of the pure organic nitrites prepared by Dunstan, and later on the action of the aconitines, which also had been prepared by Dunstan. The results were incorporated in papers to the Royal Society. They show that thoroughness and attention to detail which is characteristic of all Cash's work. He also investigated and wrote, among other matters, on tobacco smoking and skin irritants. His administrative work was equally thorough. For a time he was dean of the Faculty of Medicine and the University's representative on the General Medical Council. His work was acknowledged by the LL.D. of Edinburgh and, after retirement, of Aberdeen.

Cash was renowned as a fisherman as well as a pharmacologist. Once, the present writer when at a fisherman's inn in Scotland inquired from a visitor

what fly he used and he replied "Cash's". On relating the incident to Prof. Cash, he confessed to having prepared and tried his own flies. This incident illustrates the man; he was as modest of his prowess with the rod as of his abilities in other spheres. He fished nearly all the streams of the British Isles, and up to a few years ago could still be found occasionally on the banks of his beloved Don.

Prof. Cash married the youngest daughter of the Right Hon. John Bright. Her death, soon after their removal to Hereford, was a great blow to him. There are four children of the marriage, two sons and two daughters, to whom we extend our sympathy.

C. R. M.

### Dr. G. Schack-Sommer

DR. GUSTAF SCHACK-SOMMER died in London on October 16, aged eighty-two years. The sugar industry, home-grown sugar in particular, and his many friends will regret the passing of one who was blessed with a charming personality and presence, and whose interest in sugar was maintained to the last. He was unmarried. It was his intention to be present at the International Conference of Sugar Analysts in London in September, but unfortunately he was prevented by ill-health at the last moment. His family home was at Marienlyst, Elsinore, in Denmark, but at the time of his birth in 1854 his father was Danish Consul in Hamburg, and it was there that he spent his school life, although the summer vacation was always spent at Elsinore. In 1872 he was attracted to Heidelberg by the work of Bunsen, Kirchhoff and Kopp, and in 1875 he graduated and obtained his Ph.D. degree. His first professional post was in a German chemical works.

In 1877 Dr. Schack-Sommer decided to live in England and took the opportunity offered him to assist at one of the first alkali works in this country, the Newcastle Chemical Works. In 1878 he left Newcastle for Liverpool, where he joined the sugar-refining firm of Crosfield, Barrow and Co., of which he became a partner in 1884. In the same year he renounced his Danish nationality in favour of English. In 1881 he assisted in the foundation of the Society of Chemical Industry; he became a fellow of the Institute of Chemistry a few years later.

Dr. Schack-Sommer's early years in Germany had impressed upon him the benefits resulting from the growing of sugar beets, and from 1889 until 1895 he was instrumental in the growing of sugar beet in Lancashire and Ireland. Each year the results were carefully tabulated, supporting his contention that the crop was as suitable for England as for the Continent. With other pioneers, of whom Lord Denbigh and Sir George Courthorpe were the chief, he never missed an opportunity either at lectures or meetings of impressing all concerned with the merits of beet growing in this country. In 1890 he delivered a lecture which was attended by many members of Parliament interested in agriculture, and he was one of the earliest members of the British Sugar Beet Council, becoming chairman of the Liverpool section in 1895. He frequently recalled the pleasure it had



given him to be present at the invitation of Sir George Courthorpe when the first batch of white sugar ever produced from English grown beets was completed at Cantley in 1912. Earlier attempts in 1868 at Lavenham had only produced syrups.

In 1894 the refinery of David Martineau and Sons, one of the oldest established in the sugar industry, was burnt to the ground, and in the following year Dr. Schack-Sommer assisted members of the old company to carry on its tradition by the formation of a new company. Of this company, now known as Martineaus, Ltd., he became the first chairman, a position which he held for thirty years, until advancing years prompted him to retire at the age of seventy-two. His tact and ability during these years are gratefully remembered, and even in his retirement he was a frequent visitor to the place of his former labours up to within a fortnight of his death.

#### Mr. Hugh Richardson

WE regret to learn that Mr. Hugh Richardson, who for many years had a stimulating influence upon school science teaching, died on November 24 at seventy-two years of age. Mr. Richardson was educated at Bootham School, York, and King's College, Cambridge, where he graduated in 1887. In the following year he became a master on the modern side of Sedbergh School, Yorks, where he remained until 1897, when he became science master at Bootham School, remaining in that position until he retired in 1914. He was an enthusiastic teacher with unusually wide interests and fertility of ideas; and his work at Bootham School represented science teaching at its best, being both practical and comprehensive. The school possesses an astronomical observatory, and Mr. Richardson used this to teach astronomy by similar practical methods to those adopted by him for instruction in physics and chemistry, botany and geography. He was an examiner in botany for matriculation at the University of London in

1904-7, and was secretary of the Educational Science Section of the British Association during the years 1906-15.

When attention was being given to the application of scientific methods in the teaching of geography, Mr. Richardson, with the late Mr. A. T. Simmons, produced in 1905 the first helpful guide for use in schools, in their "Introduction to Practical Geography". He was also the editor from 1911 until 1919 of a Nature Study Series published by the Cambridge University Press.

During the last twenty years Mr. Richardson has led the life of an enlightened country landlord in Northumberland, planting trees, studying butterflies and their natural history relationships and raising varieties of primulas and gentians. He maintained to the last a keen interest in all developments of science and their relation to human life and will be remembered with affection and esteem by all who came in contact with him in educational and scientific circles.

WE regret to announce the following deaths:

Sir John Bland-Sutton, Bt., president of the Royal College of Surgeons in 1923-26, on December 20, aged eighty-one years.

Prof. F. A. Laws, emeritus professor of electrical measurements in the Massachusetts Institute of Technology, on November 12, aged sixty-nine years.

Prof. R. F. C. Leith, emeritus professor of pathology and bacteriology in the University of Birmingham, on December 14, aged eighty-two years.

Sir John Robertson, C.M.G., O.B.E., professor of hygiene and public health in the University of Birmingham, on December 16, aged seventy-four years.

Prof. H. Westergaard, formerly professor of statistics in the University of Copenhagen, known for his statistical work in connexion with population and other social problems, on December 13, aged eighty-four years.

## News and Views

### Twelve Notable American Inventions

THE granting of patents in the United States was provided for in the Constitution, and on April 10, 1790, Congress specified how patents were to be issued. It was, however, not until an act of July 4, 1836, that the Patent Office was established under a Commissioner. In that year, too, the Patent Office started numbering serially the patents issued. In connexion with the centenary of these events, a list of twelve of the inventions that have done most to change life in America, together with the inventors' names, has been drawn up. The list is as follows: The telephone, Alexander Graham Bell (1847-1922); the electric telegraph, Samuel Finley Breese Morse (1791-1872); the electric light, the cinema and the

gramophone, Thomas Alva Edison (1847-1931); the commercial steamboat, Robert Fulton (1765-1815); the aeroplane, Wilbur Wright (1867-1912); the air-brake for trains, George Westinghouse (1846-1916); the linotype machine, Ottomar Mergenthaler (1854-99); the sewing machine, Elias Howe (1819-67); the cotton gin, Eli Whitney (1765-1825); the vulcanization of rubber, Charles Goodyear (1800-60); a practical reaping machine, Cyrus McCormick (1809-84); and aluminium manufacture, Charles Martin Hall (1863-1914). The compilation of any such list is always a matter of great difficulty, but there can be no question that the inventors and inventions here recalled are truly representative of the great contributions to mechanical progress by men of American nationality.



## Coulomb and Structural Engineering

To mark the bicentenary of the birth of Charles Augustin Coulomb (1736-1806), to which reference was made in *NATURE* of June 13, p. 976, Mr. S. B. Hamilton read to the Newcomen Society on December 16 a paper dealing with his work as a "Pioneer in the Science of Construction". After briefly sketching Coulomb's career, Mr. Hamilton dealt first with Coulomb's paper written in 1773 entitled "Essay on the Application of the Rules of Maxima and Minima to Statical Problems Relating to Architecture". This paper, which has never been published in English, was concerned with beams, piers and arches. Mr. Hamilton then turned to the researches of Coulomb on torsion, and after reviewing the work of Galileo, Mariotte, Hooke, La Hire and many others, he said that Coulomb, in considering the strength of materials, realized that brittle materials subject to crushing failed by shear; that he recognized the truth of Hooke's law and gave it its true place in elastic theory; that his theories of bending and twisting, although incomplete, were a sound contribution to knowledge, and still provide the basis of everyday calculations; that by a stroke of genius he anticipated the modern view that elastic strains are due to distortion of the space lattice within a crystal, while plastic deformation and fracture are due to the development of slip planes; and he also derived a satisfactory *simple* method of calculating the thrust of earth against retaining walls, and made a sound contribution to the study of masonry arches.

## Air Raid Precautions

THE sixth of the handbooks issued by the Air Raid Precautions Department of the Home Office is entitled "Air Raid Precautions in Factories and Business Premises" (London: H.M. Stationery Office, 1936. 6*d.* net), and is intended primarily for factory occupiers, for occupiers of large commercial premises and other employers of labour, on whom would rest in time of emergency a responsibility for the protection of their employees while at work and the safeguarding of their property. The handbook explains that the air raid precautionary services which are being organized by local authorities all over the country should be supplemented by the individual efforts of householders and of employers of labour. It is suggested that in undertakings employing considerable numbers of workers, a scheme of air raid precautions embracing as many as possible of the services required should be worked out. The importance of close co-operation with the local authority of the area is stressed. Since in the event of air attack it would be impossible to improvise the necessary precautionary measures at short notice, the measures to be adopted should be surveyed at the present time and the necessary plans and preliminary arrangements made for putting them into force without delay. The handbook contains detailed guidance on means of protecting employees against gas, and blast and splinters from high-explosive bombs; the safeguarding of property and material from damage, and arrangements for emergency

repair work; first-aid facilities; the organization of adequate fire-fighting appliances, including special measures to deal with incendiary bombs; decontamination of material affected by persistent gas; provision of emergency communications and steps to ensure the effectiveness of lighting restrictions. Employers of labour are recommended to prepare schemes covering these aspects of air raid precautions and to arrange for their employees to receive training in the duties involved.

## Celtic Studies

MR. J. M. DE NAVARRO, in his John Rhys Memorial Lecture for 1936, delivered before the British Academy on December 17, surveyed the history of research in an early phase of Celtic culture, dealing with the La Tène period of the European Iron Age, in which the Celtic peoples emerged from the half light preceding the dawn of written history. He pointed out that the geographical extension of the La Tène civilization and its association with Celtic peoples was first determined by Sir Augustus Franks. Subsequent research has tended to confirm his views. No serious contribution to the study of this civilization was made before the fifties and sixties of the last century, when Thurnham, Franks and the German archaeologist Lindenschmidt made research possible by assembling various La Tène types into a definite group. The problem was at first approached in the light of literary evidence. Therefore, Mr. de Navarro went on to show, special importance is attached to the typological work in 1885 of Tischler, which resulted in his division of the La Tène period into three phases, and the work five years later of Sir Arthur Evans on the Aylesford urnfield, a contribution of which the significance is felt more to-day than it was then. After reference to Reinecke, Déchelette and others, special mention was made in dealing with post-War activities in this field to the work of Jacobsthal, who like Reinecke was a trained classical archaeologist. He viewed the La Tène style on its own merits, and not as a mere barbaric reflection of classical art. Finally, in discussing the locality in which the La Tène civilization originated, M. de Navarro expressed himself as in agreement with Déchelette and Dr. R. M. Wheeler in placing it in the region of the rich Early La Tène chieftains' graves of the middle Rhenish area.

## Central American Studies: The Copan Project

DR. A. V. KIDDER, reporting on the work of the Division of Historical Research of the Carnegie Institution, Washington, D.C. (Year Book, Carnegie Institution of Washington, 1935), in Central America during the year 1935, records two additions to the already wide range of subjects embraced in the Institution's scheme of correlated research in the archaeology, ethnography, physical anthropology and human ecology of Yucatan and Honduras. The new activities are the Copan Project and the Maize Survey. The Copan Project is a joint undertaking with the Government of Honduras to conserve and



make available for scientific study and lay observation outstanding examples of the architectural and sculptural art of the ancient Maya. Similar work has already been carried out by the Institution on the temples of Chichen Itza and the stelæ of Quirigua. Copan is a centre in which are the finest products of the art of the Old Empire of the ancient Maya. It has the added interest that not only was it one of the first sites investigated by those pioneers of Central American archæology, Stevens and Catherwood, in the earlier half of the nineteenth century, but it was also the site from which A. P. Maudslay obtained, at his own expense and with immense difficulty and labour, his famous collection of plaster casts of architectural and artistic detail, of which examples are now displayed in the British Museum, after many years of neglect. The operations of the Institution at Copan began in 1935 under Mr. Gustav Stromvik, and have already produced important chronological data relating to pottery found at the base of re-conditioned stelæ.

#### The Maize Survey

THE Maize Survey has been established by the Institution in co-operation with the United States Department of Agriculture, officers from the Department being seconded for the purpose. The object of the survey is to investigate the origin of maize and to make a study of the maize agronomy of the Maya area. Although maize is the cereal which made possible the rise of pre-Columbian American civilization, its ancestry is problematical and it is not known certainly where and when it was brought under cultivation—a question having an intimate bearing on the beginnings of higher New World culture, including that of the Maya. In reporting on the results of a preliminary survey, which lasted for about a month in the field, Messrs. R. A. Emerson and J. K. Kempton offer certain tentative conclusions, which will serve to throw some light on the density of the ancient population and the relative proportions of the urban and agricultural population. The cultivation of maize, as at present practised, is on the milpa system; that is, a plot, after being burned off, is cultivated for two years, when it is allowed to revert to forest conditions, taking about eight to ten years to become completely re-established and ready for burning off again. Consumption is at an average rate of 1.6 lb. per head per day, which gives an annual consumption by a family of two adults and three children requiring from three to four acres under cultivation. This is about the amount which the Indians now claim to cultivate. The milpa system is the only system possible in Yucatan, even with modern tools and transport, and may, therefore, be presumed to be that followed by the ancient Maya. There is no evidence that it might not be followed indefinitely. The region, as thus cultivated, is capable of supporting a population of fifty persons per square mile, with ten persons as non-agricultural urban inhabitants. Maize cultivation has now completely supplanted the cotton grown by the ancient Maya, and only a small quantity of tobacco is grown.

#### New Exhibits in the Museums at Kew

THROUGH the generosity of various firms, the Royal Botanic Gardens, Kew, have recently acquired some additional specimens of general interest to the public. A new set of examples in Museum IV showing the various processes in the manufacture of a modern tennis racket has been presented by Messrs. F. H. Ayres, Ltd. The old method of making a tennis racket was to bend a single strip of ash into the required shape, but now a better process has been developed by the use of laminated wood of various kinds. In the modern examples on exhibit, the outer layer is of English oak, the innermost is of ash, and the several ply between are of Canadian birch and English beech with an insertion of walnut. The wedge at the top of the handle is of English sycamore, the top and side clasps are of Malayan lauan, whilst the wedge bend is of Canadian rock elm. A very carefully prepared series of veneers is shown in Museum No. III. The samples shown have been presented by Messrs. John Wright and Sons (Veneers), Ltd., Avon Wharf, Mile End Road, E.3, many of them having been supplied by the firm for the interior decoration of the *Queen Mary*. The veneers are cut from logs obtained from many parts of the world, some of the species being rare and not even yet known botanically. By very thin cutting in various directions a single tree supplies a great quantity and range of veneers, and very large sheets are obtained by cutting around the tree with a rotary machine. In the same Museum (No. III) new exhibits include a fine series of photographs by Dr. I. B. Pole-Evans, which give a good idea of the floral regions of South Africa, and alongside are bouquets of some of the beautiful everlasting flowers (mostly Composites) from the same region. These have been sent by Dr. Fourcade, Humansdorp, and Dr. Muir, Riversdale. In the large Indian case at the west end of the building are displayed a series of botanical paintings of Swiss alpine plants by the late Miss Sidney E. Forster and presented by Miss A. E. Pepys in 1934, together with a fine set of coloured postcards of similar subjects from the private collection of the Director.

#### 'Degassing' by Electricity

IN *World Power* of October an interesting device is described for 'degassing' underground channels, such as sewers, drains and conduits, which has been used successfully abroad. Many large towns have records of street explosions proving the dangers arising from fortuitous concentration of gases such as methane, ether and benzene arising from the greater use of petrols in vehicles and the increasing variety of industrial chemical processes. As a rule, these gases are heavier than air, and become highly explosive when mixed with it. The apparatus consists of a motor-driven centrifugal suction fan. This is connected by suitable tubing to a floating suction head. The heavy gases are collected as nearly as possible at the level of the water at the suction head and pass through the tube with considerable velocity to the fan in the container. The power taken to



drive the fan is only nine hundredths of a horsepower, and its capacity is a third of a cubic metre per second. The electrical vehicle used for transporting the degasser is operated by an 80-volt battery. According to recent experiments, an area contained by a circumference of about 300 metres and covering sewers approximately 1,000 metres in total length can be degassed in 10-15 minutes. It was proved that the ordinary method of circulating fresh air in the system was useless and sometimes dangerous.

#### Effects produced by Ultra-Sonic Vibrations

AN abstract of a paper read by Dr. L. A. Chambers of the School of Medicine of the University of Pennsylvania to the Institute of Radio Engineers, on the effects produced by intense sounds on liquids, has been issued by Science Service, of Washington, D.C. The intense sounds produce impacts on the liquids comparable to mechanical blows and make changes in them which will sometimes be useful in science and industry and should prove most useful in the field of medicine. Dr. Chambers uses sound vibrations having a frequency of 1,200 cycles per second and an intensity which is at least equal to one hundred times that of a large orchestra when playing together. These vibrations are produced by electric oscillators and kindred devices. When milk has been subjected to these vibrations, it acts as if it were purely homogeneous. The cream cannot be made to separate from it, and it is stated that it is now more digestible. Rapid progress is being made in the field of medical research, and it has been shown that certain organisms are killed by the pressure pulses. Dr. Chambers' researches have shown that these intense mechanical vibrations will be most useful for the preparation of serums. Whisky subjected to this treatment aged very rapidly. Samples subjected to it for seven hours produced a whisky which experts stated to be equivalent to one which had been aged in the wood for four years in the usual way.

#### Forests in the Canadian Prairie Provinces

A FOREST SERVICE BULLETIN, No. 88, has been issued under the auspices of the Department of the Interior, Canada (Ottawa, Printer to H.M. the King, 1936) entitled "Forest and Forest Industries of the Prairie Provinces" by J. D. B. Harrison of the Division of Forest Economics. The Prairie Provinces occupy a part of the interior continental plain of North America and have thus many characteristics which differentiate them from other parts of the Dominion. A National Forest Inventory was commenced jointly in 1929 by the Dominion and provincial forest authorities but had to be retarded owing to the general economic situation; in spite of this it has proved possible to collect a large amount of information on the subject of these Prairie Provinces and this the author summarizes in the present bulletin. A brief but comprehensive review of the principal factors affecting the forests, together with a description of the forests themselves, is given. The dominance of agriculture as the principal industry of the region is emphasized, and questions

of population and of communications dealt with, in order to place the forest resources in their proper economic perspective. Sufficient historical material is included, in the appropriate chapters, to explain the course of events leading up to the present situation. The bulletin is written by an economic research officer from the purely economic point of view. It is, however, none the less disquieting to observe that the forests of a country are still mainly regarded from the point of view of what they can be made to yield in produce to man, whilst the protection they offer to mankind as a whole, and to certain of the natural resources of the country, are so little appreciated until almost irretrievable damage by over-exploitation has been done.

#### Agricultural Statistics

THE International Institute of Agriculture, Rome, has now published the sixth of its economic commentaries, "The World Agricultural Situation in 1934-5" (price 25 lire). As in the preceding issue, the volume is divided into two parts, the first of which deals with world agriculture and the second with the individual policy and conditions in the different countries. Both sections contain a wealth of interesting material of which it is impossible to give more than the briefest outline. Under the first heading, an analysis is made of the more important changes and trends in world economy as influenced by national planning, together with a survey of the market conditions of the principal agricultural crops and livestock. The year under review was a period of adjustments and adaptations involved in the carrying out of schemes of planning and control rather than a period of new initiations in economic organization, the outstanding feature being the increasing development of economic autarchy, which in theory stands almost universally condemned. The effects of this tendency, economic, political and technical, are discussed at length, and it is shown that greater stability is now being sought by the formation of large economic combinations between countries usually with close political associations. Further, the various forms of industrialization that are taking place in the so-called agricultural countries are shown to be producing far-reaching repercussions upon international economic relations. The information in the second part is principally concerned with Government measures for farm relief and the economic conditions of agriculture prevailing in the various countries. More than thirty countries are considered, information with regard to Austria, Portugal and Portuguese Colonies being included in this issue for the first time. Data for Argentina and Poland which were omitted in the last issue of the commentary are again included.

#### Medical Centre for Moscow

A LARGE medical centre which will include the All-Union Institute of Experimental Medicine, the institutes of the State Health Department, the Second Moscow Medical University and a traumatological institute, will be built on the outskirts of Moscow



between Pokrovskoye-Streshnievo and Khoroshevsky Serebrianny Bor in 1937. Among the buildings already under construction on the site are the Epidemiological and Microbiological Institutes of the State Health Inspection Department, veterinary stations for horses, laboratories where horse serums and vaccines will be prepared and a department to house small animals for experimental purposes. The Traumatological Institute will have a children's clinic for the study of common injuries, especially those sustained in street accidents. An Orthopaedic Department, a special jaw clinic, and a large department for mechanical therapy are also included in the plans for this Institute. The buildings of the All-Union Institute of Experimental Medicine will be commenced next spring and will occupy a site of 1,000 acres. The Institute will also serve as a post-graduate medical school.

#### Gold Coast Surveys

THE report of the Gold Coast Survey for 1935-36 (Accra, 1936. 1s.), while recording a steady development of useful work, lays stress on the want of resources for the adequate survey of the Colony. It is the difficulty which most colonial surveys have to face and represents the results of a short-sighted policy. The greater part of the Northern Territories is completely unmapped. In the south and in Ashanti only part of the primary triangulation is completed. Development of prospective mining areas is liable to be checked by want of geological surveys, which cannot be carried out without a topographical map. Air surveys have been considered, but the two difficulties are much densely forested country and a lack of fixed points from which to work. Another urgent matter is the extension of geodetic levelling. An old network of levels exists, but requires checking with modern standards of accuracy.

#### Steam Locomotives and Small Craft

FROM the Association of Engineering and Ship-building Draughtsmen come two pamphlets—"Steam Locomotive Design" by D. Patrick (London: The Draughtsman Publishing Co., Ltd. 4s.) and "Small Craft Types" by John A. Mavor (*ibid.* 3s.). The former discusses the design of component parts and includes all the more important details, except the boiler and its attachments. An earlier publication dealt with preliminary design, and the present work carries it on from the point at which wheel arrangements, cylinder sizes, etc., have been determined, and, with the above exception, practically completes the subject in relation to engines of normal design. In his pamphlet, Mr. Mavor gives general descriptions and data of the humbler types of craft including trawlers, tugs, lightships, dredgers, etc., and explains the special features and working conditions peculiar to each. The main outlines of their design are presented, and the methods are indicated by which the forms of structure, machinery and fittings are adapted to meet the different conditions under which these ships are navigated and operated.

#### Catalogue of Fishes

GÜNTHER'S "Catalogue of Fishes in the British Museum" was issued in 1859-70, and has long been out of print. The great work of Cuvier and Valenciennes was never finished, and Günther's is the only complete systematic monograph of the group in existence, and is therefore indispensable to ichthyologists. The time that has elapsed since Günther prepared his catalogue has seen the collection on which it was based quadrupled, and the number of known species about doubled; these factors alone would make the preparation of a revised edition a heavy task, and if to them be added the necessary study of the numerous systematic monographs and faunistic memoirs that have appeared since the catalogue was published, it is clearly one that no man could hope to complete. In these circumstances, to meet an evident demand, the Trustees of the British Museum have decided to reissue the "Catalogue of Fishes" in its original form, and at the original price of £3 9s. for the complete work in eight volumes. It will be available early in 1937.

#### Pathology and Bacteriology at Leeds

THE annual report of the Department of Pathology and Bacteriology of the University of Leeds, recently issued, by Profs. M. J. Stewart and J. W. McLeod, gives an account of the teaching and research work and routine examinations conducted in the Department during 1935. The research work includes the systematic investigation of industrial pulmonary affections, studies on new growths, and an investigation of types of the diphtheria bacillus present in six thousand cases of diphtheria occurring in England, Scotland, Ireland and Germany. Prof. R. D. Passey contributes a summary of researches carried out in the Department of Experimental Pathology and Cancer Research.

#### The Indian Earthworm

TEN years after its first appearance, Prof. K. N. Bahl's monograph on *Pheretima*, the Indian earthworm, has passed into a second edition (Lucknow: Lucknow Publishing House, 1936). That is sufficient to indicate that the work has found its place as a guide to teachers and students of Indian zoology, as one of the excellent series of Zoological Memoirs on Indian Animal Types, projected and edited by Prof. Bahl. The first edition was favourably reviewed in NATURE (119, 557; 1927), and the second is even better in that the author has revised the text and incorporated new information and illustrations.

#### Birds of Agricultural Importance

THE Ministry of Agriculture and Fisheries has issued, bound in an attractive folder, a group of twenty-three "Advisory Leaflets", dealing with the agricultural activities of common British birds. Several of these have already been referred to in NATURE. The price is 1s. 6d. net.



## The Night Sky in January

IN the middle of the month at 22<sup>h</sup>, the full pageantry of the winter constellations is on the meridian; the segment of bright stars is outlined by Capella (near the zenith), the Pleiades and Aldebaran, Rigel, Sirius, Procyon, Castor and Pollux, and so back to Capella. South of Orion's belt may be seen with the naked eye the hazy patch that marks the great gaseous nebula. The planet, Venus, is a brilliant object in the early evening sky; it will continue to increase in brightness until the middle of March. Venus is in conjunction with the moon on January 16<sup>d</sup> 15<sup>h</sup> and with Saturn on January 24<sup>d</sup> 2<sup>h</sup> after the two planets have set, their closest approach in the sky being 1.9°. Mars is a morning star as well as Jupiter, the latter rising only about one hour before the sun in mid-January. The phases of the Moon are: Last Quarter, January 4<sup>d</sup> 14<sup>h</sup>; New Moon, January 12<sup>d</sup> 17<sup>h</sup>; First Quarter, January 19<sup>d</sup> 20<sup>h</sup>; Full Moon, January 26<sup>d</sup> 17<sup>h</sup>. The only bright star to be seen occulted from Greenwich is  $\tau$  Tauri (mag. 4.3) whose disappearance takes place on January 22<sup>d</sup> at 18<sup>h</sup> 0.6<sup>m</sup>. Members of the Quadrantid meteor shower may be looked for about January 2-3, the radiant point being at R.A. 15<sup>h</sup> 20<sup>m</sup> and Dec. 53° N. The times of minima of Algol accessible to observation are: January 10<sup>d</sup> 4<sup>h</sup>, 13<sup>d</sup> 1<sup>h</sup>, 15<sup>d</sup> 21<sup>h</sup>, 18<sup>d</sup> 18<sup>h</sup>, 30<sup>d</sup> 5<sup>h</sup>.

## Announcements

SIR ARTHUR HILL, Director of the Royal Botanic Gardens, Kew, has been awarded a Veitch Memorial Gold Medal of the Royal Horticultural Society for his services to horticulture.

THE American Association for the Advancement of Science will hold its ninety-ninth meeting in Atlantic City on December 28-January 2. The address of Dr. Karl T. Compton, the retiring president, will be entitled "The Electron: its Intellectual and Social Significance". The president-elect is Dr. Edwin G. Conklin. A new feature of this forthcoming meeting is an attempt to bring together for general programmes all those attending the meeting. January 1 has therefore been set aside as "Association Day". On this day, an Association luncheon will be held at which all members may participate; a general lecture on changes in the conception of cancer will be given by Dr. Walter Schiller of Vienna; and in the evening there will be an exhibition of scientific films. The Association will adjourn its sessions to Philadelphia on January 2.

THE well-known publishing firm of Ferdinand Enke in Stuttgart celebrates on January 1, 1937, the hundredth anniversary of its foundation. This firm specializes in works on medicine, natural science and law, and has published a number of important works and periodicals on these subjects.

DR. PAUL RAMDOHR, professor of mineralogy at Berlin, has been elected a member of the Geologiska Föreningen of Stockholm.

PROF. RICHARD KOLKOWITZ, professor of botany in Berlin, has been elected an honorary member of the Botanical Society of Japan in Tokyo.

THE first award of two thousand dollars of the Squibb fellowship at Harvard University for research in organic chemistry by E. R. Squibb and Sons, New York, has been made to William P. Campbell of Hagerston, Md., for research in phenanthrene.

THE Institutè of Malariaology at Rome, directed by Prof. G. Bastianelli, has sent a mission to Abyssinia to study various aspects of malaria. The chief members of the mission are Prof. G. Lega (pathology and clinical medicine) and Prof. G. Raffaele (entomology, epidemiology and prophylaxis).

A STUDENTSHIP is offered to a young, recently qualified medical graduate who wishes to acquire experience in cancer research from the biological point of view and particularly from the virus aspect. The studentship is tenable at the Lister Institute for three years. Further information can be obtained from the secretary, British Empire Cancer Campaign, 12 Grosvenor Road, S.W.1.

H.M. STATIONERY OFFICE is now acting as an agent for the sale of publications of the British Museum. New publications of the Museum will, in future, be regularly listed in "Government Publications", the monthly catalogue of the Office.

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

Evening lecturer in electrical machinery and design in the West Ham Municipal College—Romford Road, Stratford—The Principal (December 31).

Assistant curator in charge of the Decorative Department in the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (January 4).

Lecturer in heat engines in the Wimbledon Technical College, Gladstone Road, S.W.19—The Principal (January 5).

Assistant lecturer in dairying in University College of Wales, Aberystwyth—The Registrar (January 11).

Lecturer in education and psychology in Rhodes University College, Grahamstown—The Secretary, Office of the High Commissioner for South Africa, Trafalgar Square, London, W.C.2 (January 18).

Botanist, advisory officer (Botanical Division), advisory officer (Soils and Chemistry Divisions), and junior assistant (Experiment Station) in the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, London, S.W.7 (January 31).

University professor of pathology in the British Postgraduate Medical School—The Academic Registrar, University of London, W.C.1 (April 16).

Head of the Department of Dairy Chemistry in the National Institute for Research in Dairying, Shinfield, Nr. Reading—The Secretary.



## 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. 1102.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

### Isotopic Weights by the Doublet Method

CONTINUING work with my second-order focusing mass-spectrograph, the doublet 31 formed by P and CF has been measured by the use of a mixture of phosphine, carbon tetrafluoride and helium in the discharge. On some of the plates obtained well-matched doublets appeared at 28 due to Si and CO derived from the walls of the tube. This was very fortunate, for the intensities of these lines are virtually beyond any ordinary control. The value of the packing fraction of  $^{28}\text{Si}$  deduced is only slightly different from that already given.

The first determination of the packing fraction of an isotope of sulphur has been made by means of the doublet  $^{32}\text{S}$  and  $\text{O}_2$  obtained by means of a mixture of sulphur dioxide, oxygen and helium.

Measurement of the chlorine isotopes was first attempted with heavy phosphine  $\text{PD}_3$  mixed with a little  $\text{CCl}_4$ . This behaved very badly in the discharge tube, and a much better result was later obtained by the use of propane and methyl chloride which, when suitably mixed, gave three doublets 36 due to  $\text{H}^{35}\text{Cl}$  and  $\text{C}_3$ , 37 due to  $^{37}\text{Cl}$  and  $\text{C}_3\text{H}$  and 38 due to  $\text{H}^{37}\text{Cl}$  and  $\text{C}_3\text{H}_2$ . The masses of the chlorine isotopes were calculated from the first two and the result for  $^{37}\text{Cl}$  confirmed by measurements of the third. The following are the results:

Doublet	Number of doublets measured	Difference in packing fraction	Difference of mass
$^{28}\text{Si}$ , CO	11	$6.15 \pm 0.2$	0.0172
$^{31}\text{P}$ , CF	18	$7.88 \pm 0.15$	0.0244
$^{32}\text{S}$ , $\text{O}_2$	18	$5.53 \pm 0.1$	0.0177
$\text{H}^{35}\text{Cl}$ , $\text{C}_3$	8	$6.25 \pm 0.2$	0.0225
$^{37}\text{Cl}$ , $\text{C}_3\text{H}$	22	$11.14 \pm 0.2$	0.0412

Symbol	Packing fraction	Isotopic weight
$^{28}\text{Si}$	-4.90	$27.9863 \pm 0.0007$
$^{31}\text{P}$	-5.30	$30.9836 \pm 0.0006$
$^{32}\text{S}$	-5.53	$31.9823 \pm 0.0003$
$^{35}\text{Cl}$	-5.71	$34.9800 \pm 0.0008$
$^{37}\text{Cl}$	-6.10	$36.9775 \pm 0.0008$

In calculating these, I have used the values of the doublets appearing in my previous letters<sup>1</sup>; however, since these appeared, other workers' values have been published. K. T. Bainbridge and E. B. Jordan<sup>2</sup>, using a double focusing mass-spectrograph of about the same dispersion and even greater resolving power than mine, give for the fundamental doublet  $\text{O}_2\text{CH}_4$  a difference of mass of  $0.0369 \pm 0.0002$ , whereas I obtained  $0.03601 \pm 0.00024$ . The discrepancy only amounts to 5 parts in  $10^5$  in the absolute mass, but it is well outside the probable error.

I have therefore repeated my measurements with special precautions. The electric deflecting plates were resurfaced, a new front slit was fitted and a different form of discharge tube used, but the mean value given by thirteen doublets was virtually the same as mine given above. No individual doublet in this group even reached the higher figure.

As a final check and to eliminate any possible difference between atomic and molecular lines, I

decided to measure the doublet  $\text{CO}$ ,  $\text{C}_2\text{H}_4$ , which will obviously measure the same difference of mass, though less accurately. To get matched pairs in this case has proved extremely difficult, but after long running with pure ethane, this has been done and measurements of ten doublets definitely support my value.

Bainbridge and Jordan do not state with what unit their dispersion coefficients were calibrated. I used the bromine lines to calibrate the instrument originally, and for these two particular doublets was able to check the figures to within a fraction of 1 per cent by the positions of the neighbouring lines  $\text{CH}_3$ ,  $\text{OH}$  in one case, and  $\text{C}_2\text{H}_3$ ,  $\text{C}_2\text{H}_5$  in the other. The discrepancy therefore remains quite unexplained.

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Cavendish Laboratory,  
Cambridge.

Dec. 8.

<sup>1</sup> NATURE, 137, 357 (February 29, 1936); 137, 613 (April 11, 1936).

<sup>2</sup> Phys. Rev., 49, 883 (1936).

### Selective Absorption of Neutrons in Silver

WE have measured the absorption in boron of the neutrons which excite  $\gamma$ -rays in silver. The arrangement used is shown in Fig. 1. The silver in the form of a hollow cylinder 4 mm. thick surrounding the counter was shielded from the effects of stray neutrons by layers of  $\text{B}_4\text{C}$  about 5 mm. thick. After being slowed down by the paraffin block and the thermal neutrons filtered out by a cadmium sheet 0.5 mm. thick, the neutrons passed through the  $\text{B}_4\text{C}$  absorber placed directly beneath the silver.

Fig. 2 shows the curve obtained when the  $\gamma$ -ray activity induced in the silver is plotted against the amount of boron contained in the absorber. The figure shows also a second set of points obtained when the system consisting of the counter, silver, etc., was lowered 5 cm. The close similarity of the two curves shows that no appreciable correction for geometry is required.

The absorption curve of Fig. 2 may be analysed into two portions as is explained in the figure:

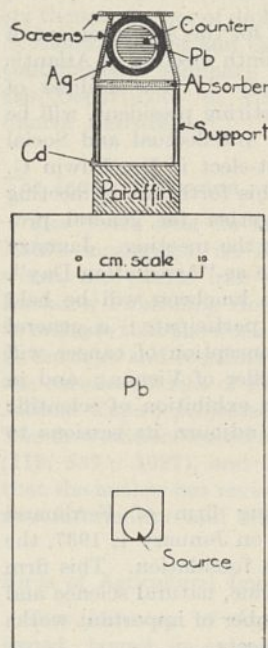


FIG. 1. Experimental arrangement.



- (i) An initial steep exponential decrease corresponding to an absorption coefficient of  $8.1 \text{ gm.}^{-1} \text{ cm.}^2$ .
- (ii) A region of slow, almost linear decrease. Supposing this to be part of an exponential curve, the

( $= 0.038 \text{ volt}$  if  $T = 290^\circ \text{ K.}$ ), and taking the value for the absorption coefficient in boron of thermal neutrons to be  $28 \text{ gm.}^{-1} \text{ cm.}^2$  as found by Goldsmith and Rasetti<sup>1</sup>, the energy of the first resonance level

for the neutrons which produce  $\gamma$ -rays in silver works out at  $0.45 \text{ volt}$ , whilst that corresponding to the harder component comes to about  $500 \text{ volts}$ . Since the second component probably consists, however, of the combination of a number of exponentials, the actual spacing of the first and second levels is probably a little smaller than this. Such a value is in good agreement with Bethe's<sup>2</sup> approximate calculations of the spacing of nuclear levels.

We are indebted to the Commonwealth Radium Laboratory for the supply of emanation with which this work was carried out, and particularly to Mr. W. N. Christiansen, who prepared the sources. We also wish to thank Prof. T. H. Laby for assistance in preparing this work for publication.

E. H. S. BURHOP.  
R. D. HILL.  
A. A. TOWNSEND.

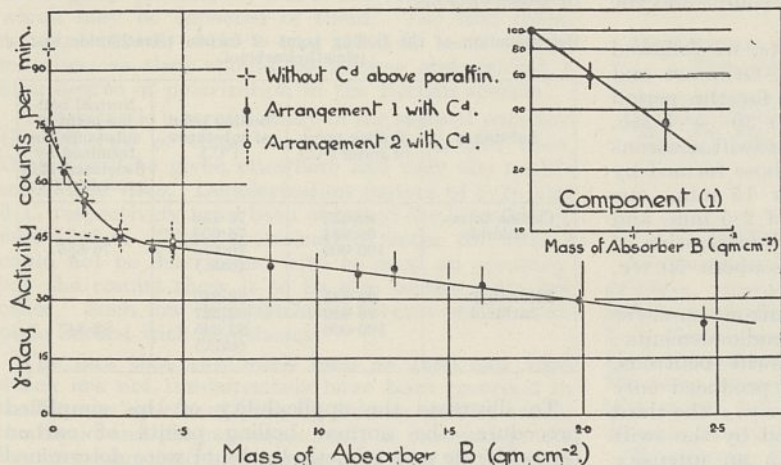


FIG. 2.  $\gamma$ -Ray activity for different boron thicknesses. Three sets of readings are plotted as explained in the text. Inset—Absorption curve for component (1) of the text.

absorption coefficient is  $0.24 \text{ gm.}^{-1} \text{ cm.}^2$ . Most likely the curve is a combination of several exponentials. Extrapolating the second component to zero boron thickness, it is found that approximately one third of the total activity is due to component (i).

The early part of the absorption curve was also determined without the cadmium filter. The points obtained are also shown in Fig. 2. It is seen to be almost identical with the previous curves except that the point for zero absorber lies about 25 per cent higher. This represents the amount of the  $\gamma$ -ray activity due to neutrons of thermal energy, and is of the same order of magnitude as the activity produced by that component having an absorption coefficient in boron of  $8.1 \text{ gm.}^{-1} \text{ cm.}^2$ .

On removal of the neutron source, the counter immediately registered its normal natural count, showing that the  $\gamma$ -rays do not arise from a decay process of appreciable period.

It is interesting to note the difference between the above curve and the curves obtained for the absorption of those neutrons which excite the 22 second and the 2.3 minute activities in silver. Both the latter curves can be analysed into an exponential part and an almost constant background representing about 15 per cent of the total activity (when samples of silver  $0.5 \text{ mm.}$  thick are used as detector). Measurements that have been made on the 22 second period indicate an absorption coefficient in boron (for the exponential portion) of  $3.25 \pm 0.15 \text{ gm.}^{-1} \text{ cm.}^2$ . For the 2.3 minute period, much less accurate measurements indicate for the corresponding coefficient a value of about  $1.5 \text{ gm.}^{-1} \text{ cm.}^2$ .

Since there are only two known isotopes of silver, it is difficult to decide the origin of the two radioactivities and the  $\gamma$ -ray emission. A possible explanation of the above curves would be that a nucleus can possess two systems of energy levels, one corresponding to  $\beta$ -decay and the other to the emission of  $\gamma$ -radiation.

Assuming that :

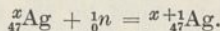
- (i) the  $1/v$  law holds for boron absorption ;
- (ii) the thermal neutrons which are strongly absorbed in cadmium have energies of  $\frac{3}{2}kT$

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<sup>1</sup> Goldsmith and Rasetti, *Phys. Rev.*, **50**, 328 (1936).  
<sup>2</sup> Bethe, *Phys. Rev.*, **50**, 332 (1936).

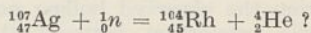
### Activation of Silver by Neutrons

THE different authors who have dealt with the radioactivation of silver by neutrons agree in admitting the formation of two radio-elements such as would result from a process of neutron capture without emission of heavy particles. One would thus have in both cases



The first radio-element would have a short period : 22 sec. (Amaldi and co-workers; Alichanow; Gaertner, *et al.*) or 26 sec. (Livingston, Henderson and Lawrence). The second one has a longer period 2.3 min. (Amaldi and others, Hevesy and Levi, *et al.*) or 154 sec. (Livingston and others). Bjerger and Westcott<sup>1</sup> alone have found a period of 40 sec., which is different from the generally admitted period.

Further, it seems surprising that the process of radioactivation mentioned above should be the only one observed with silver. Undoubtedly it is the most frequent for the elements beyond a certain atomic number. But would it not be possible to have



Now  ${}_{45}^{104}\text{Rh}$  radioactive with a period of 44 sec. is known and results from the irradiation of rhodium by neutrons. Is it not this radio-element that has been observed by Bjerger and Westcott ?

In order to verify this conclusion, I have undertaken the following experiments :

- (a) Irradiation of a silver sheet with the neutrons of a radium-beryllium source, the irradiation being



continued for 0.5 min., 1 min., 2 min., followed by observation, with a Geiger-Müller counter, of the activity and of its variation with time; (b) irradiation of the same sheet for the same periods, but with 4 cm. paraffin interposed between the source and the silver.

For the interpretation of the results, we followed the method suggested by McLennan, Grimmet and Read<sup>2</sup>. Repeated experiments gave for the period in case (a)  $47 \pm 3$  sec.; in case (b)  $30 \pm 4$  sec. It seems thus that without paraffin, the swift neutrons form a radio-element different from those formed by slow neutrons. After irradiation for 15 min., one finds a curve which shows a period of 2.5 min. and another period which, in the case of interposition of paraffin, is about 30 sec. and reaches about 50 sec. when no paraffin is interposed.

It seems thus that the action of neutrons on silver determines the formation of three radio-elements: the first one is produced by the swift neutrons, period about 50 sec.; the second is produced only by the slow neutrons, period about 30 sec.; the third with a period of 2.5 min. is produced by the swift and by the slow neutrons, but with an intensity enhanced by interposing a hydrogenated substance between the source of neutrons and the silver.

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Nov. 23.

<sup>1</sup> Bjerger and Westcott, *NATURE*, **134**, 177 (1934).

<sup>2</sup> McLennan, Grimmet and Read, *NATURE*, **135**, 505 (1935).

#### A Simplified Procedure for Determining Normal Boiling Points by the Comparative Method\*

ŚWIĘTOSŁAWSKI'S method<sup>1</sup> for determining the normal boiling point of a substance by comparing its boiling point with that of water at three or more pressures, and applying his equation involving the ratio of the  $dt/dp$  coefficients of the two liquids, can be simplified by working as nearly as possible at a pressure of one normal atmosphere. If the manostat, which equalizes the pressures in the two ebullimeters, can be adjusted previously to one normal atmosphere (as determined by the temperature of boiling of water in the barometric ebullimeter) the normal boiling point of the substance in the second ebullimeter can be measured directly.

If, as is likely to be the case, the pressure cannot be adjusted to one atmosphere within the required precision of  $\pm 0.02$  mm. of mercury, it is only necessary to make a second pair of observations at a pressure which differs so little from the first pressure that the variation of boiling point with respect to pressure can be assumed to be linear (over the small interval), both for water and for the substance under investigation. If the first pressure is below normal, the second preferably should be above normal, and vice versa. The normal boiling point can then be calculated from the observed boiling points by the use of simple proportion between the observed changes in boiling points and the correction to 760 mm. of mercury, corresponding to  $100^\circ$  as the defined normal boiling point of water. One form in which the equation may be written is

$$t_s = t_{s_1} + \frac{\Delta t_s}{\Delta t_{w_1}} (100 - t_{w_1}),$$

\* Publication approved by the Director of the National Bureau of Standards of the U.S. Department of Commerce.

in which  $t_{s_1}$  and  $t_{w_1}$  represent either pair of observed boiling points of the substance and of water, respectively, and  $\Delta t_s$ ,  $\Delta t_w$  are the changes in the boiling points occurring between the first and second pairs of observations.

Determination of the boiling point of carbon tetrachloride and of trimethylcarbinol.

Substance	Boiling point of water ( $^\circ\text{C}$ .)	Boiling point of substance ( $^\circ\text{C}$ .)	Normal boiling point of substance determined by Świątosławski's procedure ( $^\circ\text{C}$ .)
Carbon tetrachloride	99.527	76.130	76.685
	99.934	76.608	
	100.000	76.685 (calc.)	
Trimethylcarbinol	99.885	82.240	82.347
	99.980	82.327	
	100.000	82.345 (calc.)	

To illustrate the applicability of this simplified procedure, the normal boiling points of carbon tetrachloride and trimethylcarbinol were determined and compared with those obtained by Świątosławski's procedure, using the  $dt_s/dt_w$  ratio for reducing to normal pressure the boiling point actually measured. The carbon tetrachloride used for the measurements was of the fifth degree of purity on Świątosławski's scale<sup>2</sup>, having a difference of  $0.002^\circ\text{C}$ . between the boiling point and temperature of condensation in a standard differential ebullimeter. The trimethylcarbinol was of the fourth degree of purity, having a corresponding difference of  $0.007^\circ\text{C}$ . The data are given in the accompanying table.

The agreement of the data obtained by the use of the two methods demonstrates the validity and high precision of the new method. Details will be published elsewhere.

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(Guest Worker,  
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National Bureau of Standards,  
Washington, D.C.

<sup>1</sup> W. Świątosławski, *J. chim. phys.*, **27**, 496 (1930); *Roczniki Chem.*, **9**, 266 (1930).

<sup>2</sup> W. Świątosławski, IX Cong. Intern. Química Pur a Aplicada, Madrid, 81 (1934); *Roczniki Chem.*, **13**, 176, 227 (1933); *J. Phys. Chem.*, **38**, 1169 (1934); *Z. phys. Chem.*, **A**, **160**, 257 (1932).

#### Vibrations of the Ethylene Molecule

BONNER<sup>1</sup> has recently recorded seven frequencies (1619, 3009, 1341, 3069, 950, 2880 and 1654) in the Raman spectrum of liquid ethylene. In the earlier work of Dickinson, Dillon and Rasetti<sup>2</sup> on the Raman spectrum of ethylene gas, 1623.3, 3019.3, 1342.4, 3240, 3272 and 2880 were recorded. I have recently obtained an intense Raman spectrum of ethylene gas at a pressure of 40 atmospheres using  $\lambda 4358$  radiation, and have measured lines at 1626, 3020, 1343, 2880 and 1656. Thus, both Bonner and I have failed to record the lines at 3240 and 3272, and these are probably spurious.

Vibrations of the ethylene molecule and the deduction of the force constants therefrom have been the subject of recent investigations by several workers<sup>3,4,5</sup>. Six of the twelve fundamental frequencies of this molecule are active in the Raman effect, and these have been identified (see refs. 5



and 1) as 1621·3, 3019·0, 1343·9, 3069·0, 950·0 and 1100. Of these six, the last one has not yet been observed, but 3069·0 and 950·0 have been recorded by Bonner in the liquid. That they do not appear in the gas is presumably due to the very low intensity which may be expected of them. The first three, namely 1621·3, 3019·0 and 1343·9, need special mention, as they should be intense and exhibit a high degree of polarization in the Raman spectra.

I have made a careful study of the state of polarization of two of these three intense Raman lines. Details will be given elsewhere and only the results mentioned here. Depolarization factors of 0·10 and 0·17 respectively have been obtained for lines 3019·0 and 1343·9. The depolarization factor for 1621·3 could not be determined with as good an accuracy, but the results show it to be also of the same low order. Such low depolarization factors are in complete accord with the theory.

The fact that two weak lines at 2880 and 1656 which are not fundamentals have been recorded in the Raman spectrum both by Bonner and by me in the liquid and the gas respectively is interesting. As has been suggested by Bonner, 1656 may be regarded as the overtone of an inactive fundamental at 825, appearing as a result of its proximity to 1620 (similar instances occur in the Raman spectra of carbon dioxide, carbon disulphide, etc.), but the origin of 2880 is not at all clear.

S. BHAGAVANTAM.

Department of Physics,  
Andhra University,  
Waltair, India.  
Oct. 24.

- <sup>1</sup> Bonner, *J. Amer. Chem. Soc.*, **58**, 34 (1936).  
<sup>2</sup> Dickinson, Dillon and Rassetti, *Phys. Rev.*, **34**, 582 (1929).  
<sup>3</sup> Sutherland and Dennison, *Proc. Roy. Soc., A*, **148**, 250 (1935).  
<sup>4</sup> Delfosse, *Ann. Soc. Sci. Bruxelles*, B, **45**, 114 (1935).  
<sup>5</sup> Manneback and Verleysen, *NATURE*, **138**, 367 (1936).

Dissociation Energy of Carbon Monoxide and the Abundance of Elements in Stellar Atmospheres

A GREAT deal of work has been carried out by many investigators during the last two years in order to determine the heat of dissociation of carbon monoxide by means of spectroscopic methods. But as yet this very important figure is not known with any certainty, the values proposed by different authors varying between 11·06 and 6·9 e.v.; however, only the values 9·1 e.v. and less are not in contradiction with existing spectroscopic and thermochemical data.

The purpose of the present letter is to direct attention to the fact, that from all the proposed values for  $D(\text{CO})$  equal or less than 9·1 e.v., only the value  $D(\text{CO}) = 9·1$  e.v. proposed by Goldfinger, Lasareff and Rosen<sup>1</sup> and by Herzberg<sup>2</sup> is in good agreement with our actual theoretical and observational knowledge of the composition of the atmospheres of late-type stars. A detailed investigation of this question has proved that: either the heat of dissociation of CO is really  $D(\text{CO}) = 9·1$  e.v., and the related value of the heat of dissociation of CN is  $D(\text{CN}) = 5·97$  e.v., or the abundances of light atoms in the main sequence as postulated by Cambresier and Rosenfeld<sup>3</sup> and by Russell<sup>4</sup> must be entirely revised.

Owing to the important role played by  $D(\text{CO})$  in all the calculations of molecular abundances in the late-type stars, the astrophysical evidence for the proposed value of  $D(\text{CO})$  seems worth mentioning.

Details on the subject will be published elsewhere.  
M. NICOLET.

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University, Liège.

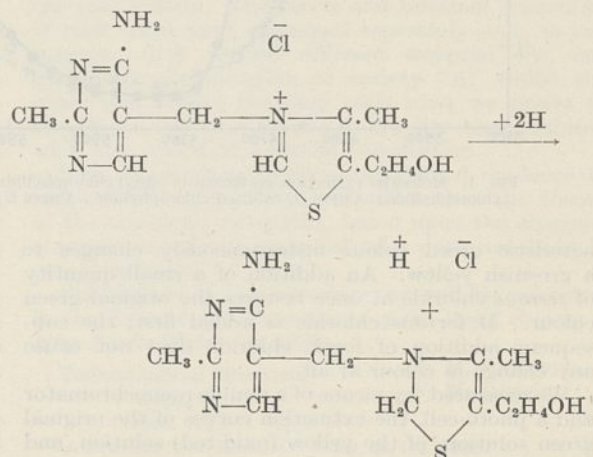
- <sup>1</sup> *NATURE*, **135**, 1077 (1935); **136**, 226 (1935); *C.R.*, **201**, 958 (1935).  
<sup>2</sup> *NATURE*, **137**, 620 (1936).  
<sup>3</sup> *Mon. Not. Roy. Ast. Soc.*, **93**, 711 (1933).  
<sup>4</sup> *Astrophys. J.*, **79**, 281 (1934).

Hydrogenation of Vitamin B<sub>1</sub>

WHEN treated with platinum-black or with hydrosulphite, vitamin B<sub>1</sub> is easily reduced. Crystalline preparations from Hoffmann-La Roche and from I. G. Farben were used. They gave identical results. Hydrogenation with platinum-black was measured in Warburg-Barcroft manometers. In phosphate solution at pH 7·5, 0·94 mol H<sub>2</sub> was absorbed per mol vitamin (average of three experiments).

To measure the reduction by hydrosulphite, the manometric method described by O. Warburg, Christian and Griese<sup>1</sup> has been used. With this method, in bicarbonate solution, the acid formation due to oxidation of hydrosulphite ( $\text{Na}_2\text{S}_2\text{O}_2$ ) to acid sulphite is measured. One mol of acid is equivalent to one atom of hydrogen. But in many cases<sup>2</sup>, in addition to that, acid is derived from the reduction process itself.

It has been found that 2·76 mols of acid are produced in the reaction between hydrosulphite and vitamin (average of four experiments). The reaction is finished after three hours at 25° C. No acid formation takes place when the vitamin is treated with sulphite at pH 7·8. This possibility had to be excluded on account of the reaction between  $\text{NaHSO}_3$  and vitamin at pH 5<sup>3</sup>. Then, of the 2·76 mols of acid, only two can be accounted for by oxidation of hydrosulphite, because only two atoms of hydrogen are added by platinum-black. The additional acid must be derived from the reduction process itself. Therefore it is assumed that the reduction takes place at the double bond closest to the quaternary nitrogen<sup>3</sup>. Then only one hydrogen is added; the other one is split into an electron and a hydrogen ion. The electron neutralizes the nitrogen and acid is formed. Tentatively the reduction of vitamin B<sub>1</sub> can be formulated as follows:





A very similar reaction takes place when the coferments of Warburg and of von Euler are reduced with hydrosulphite. According to Warburg and Christian<sup>4</sup> 2.8–2.9 mols of acid per mol coferment appear. Here, as Karrer and Warburg<sup>5</sup> have shown, two atoms of hydrogen reduce the double bond attached to a pyridylum nitrogen.

Reductions effected by hydrosulphate are similar to reductions effected by substrates in the cell<sup>1</sup>. The fact that vitamin B<sub>1</sub> is reduced by hydrosulphite makes it probable that in the cell<sup>6,7</sup> acting as a catalyst, the vitamin is reduced in the same way.

FRIEZ LIPMANN.

Biological Institute,  
Carlsberg Foundation,  
Copenhagen.  
Nov. 20.

- <sup>1</sup> Warburg, Christian and Griese, *Biochem. Z.*, **282**, 157 (1935).  
<sup>2</sup> Haas, *Biochem. Z.*, **285**, 368 (1936).  
<sup>3</sup> Williams *et al.*, *J. Amer. Chem. Soc.*, **57**, 536, 1093, 1856 (1935).  
<sup>4</sup> Warburg and Christian, *Biochem. Z.*, **287**, 291 (1936).  
<sup>5</sup> Karrer and Warburg, *Biochem. Z.*, **285**, 297 (1936).  
<sup>6</sup> Peters *et al.*, *Biochem. J.*, **27–30** (1933–36).  
<sup>7</sup> Krebs, *NATURE*, **138**, 288 (1936).

### Reversible Oxidation and Reduction of Chlorophyll

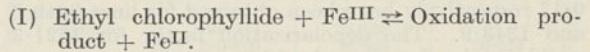
IN experimenting with ethyl chlorophyllide, for specimens of which we wish to thank Prof. A. Stoll, of Basle, we observed the following reactions which illustrate a hitherto unknown property of chlorophyll.

(1) When, to a solution of ethyl chlorophyllide in methyl alcohol, a few drops of a solution of ferric chloride in the same solvent are added, the char-

acteristic green colour instantaneously changes to a greenish yellow. An addition of a small quantity of ferrous chloride at once restores the original green colour. If ferrous chloride is added first, the subsequent addition of ferric chloride does not cause any change in colour at all.

of the recovered (reduced) green solution (Fig. 1). The oxidation causes a considerable weakening of the characteristic red band (5500–6900 Å.), without affecting strongly the violet one. The extinction curve of the recovered green solution is practically identical with that of the original chlorophyllide, apart from a slight change in the violet consisting of the disappearance of the small hump at 4600 Å., and a slight increase of absorption at shorter wavelengths, which we suspect to be due to a specific behaviour of the "C" component of chlorophyll.

It is thus highly probable that we have an equilibrium:



Another feature of the above reaction is the disappearance and reappearance of the fluorescence. The following figures show the intensity of the red fluorescence of the three solutions (excited by violet-blue light, which is absorbed by the yellow solution as well as by the green ones), measured by a photo-cell and galvanometer.

	Intensity of fluorescence (arbitrary units)
(a) Original solution (ethyl chlorophyllide in methyl alcohol, $1.5 \times 10^{-4}$ m./l.)	100
(b) Oxidized solution (same with 0.4 mgm. ferric chloride in 50 c.c.)	33
(c) Recovered solution (solution b to which 5 mgm. ferrous chloride were added immediately after reaction with ferric chloride)	96

(2) The reduction has to be carried out almost immediately (that is, not later than a few minutes) after the oxidation in order to give a complete recovery. This shows that the first oxidation product is unstable, and slowly reacts further (with the ferric chloride or possibly with dissolved oxygen). If the reduction is carried out, for example, 30 minutes after the oxidation, the green colour reappears, but the extinction curve of the reduced solution is situated somewhere between the curves A and B in Fig. 1. The fluorescence is also only partially restored. The oxidation product is especially unstable to light: a few seconds of intense illumination (by violet or blue light, but not by red light) suffice to destroy it, and no trace of recovery can be observed by adding ferrous chloride to the yellow solution after such illumination.

(3) By illuminating a methyl alcoholic solution of ethyl chlorophyllide, containing ferric chloride alone or, better, ferric chloride together with some ferrous chloride, by red light, a bleaching of the solution occurs, which is reversed as soon as the illumination ceases. The amount of the bleaching observed (that is, the decrease in the extinction coefficient for red light) was of the order of 1 per cent. (Extinction changes of this order of magnitude can be measured exactly by an optical compensation

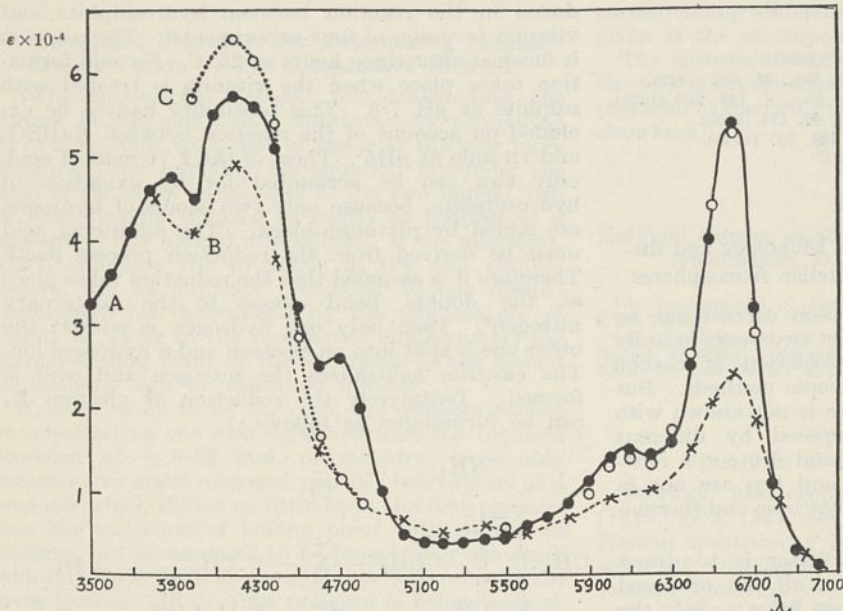


FIG. 1. Molecular extinction coefficient of ethyl chlorophyllide solutions: Curve A, original chlorophyllide; Curve B, oxidized chlorophyllide; Curve C, recovered chlorophyllide.

We measured, by means of a double monochromator and a photo-cell, the extinction curves of the original green solution, of the yellow (oxidized) solution, and

ethyl chlorophyllide, containing ferric chloride alone or, better, ferric chloride together with some ferrous chloride, by red light, a bleaching of the solution occurs, which is reversed as soon as the illumination ceases. The amount of the bleaching observed (that is, the decrease in the extinction coefficient for red light) was of the order of 1 per cent. (Extinction changes of this order of magnitude can be measured exactly by an optical compensation



arrangement described previously<sup>1</sup>.) The stationary decrease in the concentration of the absorbing chlorophyll molecules during the illumination is proportional to the light intensity, and (roughly) inversely proportional to the concentration of ferrous chloride. It increases at first with increasing concentration of ferric chloride and then becomes independent of it—showing that under these conditions each excited chlorophyll molecule reacts with Fe<sup>III</sup>. All these results agree with the assumption that the influence of light consists in shifting the equilibrium (I) to the right, that is, in speeding up the oxidation.

(4) These experiments show that ethyl chlorophyllide is reversibly oxidized by ferric chloride (that is, probably by Fe<sup>3+</sup>-ions) to some unstable intermediary product from which it can be recovered by reduction with ferrous chloride (that is, probably by Fe<sup>2+</sup>-ions), and that the oxidation is greatly favoured by illumination. These facts are obviously not without interest in connexion with the assimilation process, in which chlorophyll has to act as a catalyst for the reduction of carbon dioxide by light.

We wish to express our sincere thanks to Prof. F. G. Donnan for his kind interest in this work.

Note added in proof.

The formation of ferrous ions in the reaction between ethyl chlorophyllide and FeCl<sub>3</sub> can be proved directly by means of a spot test reaction with  $\alpha\alpha'$  dipyrrolyl. It has further been observed that the yellow solution of chlorophyllide, oxidized by FeCl<sub>3</sub>, changes to a green colour by addition of various electrolytes, for example, NaCl, CaCl<sub>2</sub>.

E. RABINOWITCH.  
JOSEPH WEISS.

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Nov. 18.

<sup>1</sup> See, for example, *J. Chem. Phys.*, 4, 497 (1936).

#### Translocation of Solutes in Plants

In my experiments on the eradication of *Dichapetalum cymosum* (Hook) Engl., one of the most toxic plants of the Transvaal, I was led to the following technique for introducing copper into the stem of the plant. The stem and branches of the plant are entirely underground and only the leaves emerge above the soil. The stem may be up to 100 ft. long. For the purpose of eradication, the stem is freed from the surrounding soil to a depth of about 9 in. and then ringbarked on a length of 2 in. for a 1 in. stem. Around this ringbarked region a mixture of the following substances is packed: calcium chloride, copper sulphate and soil in the proportion 2 : 1 : 2. The hole is then filled up again with soil. The circulation of the copper is very rapid; within twenty-four hours, leaves 15 ft. distant from the main stem are practically dead or dying. The downward movement is much slower; it takes eighteen days to kill 104 inches of the stem. The movement of the copper was followed with the help of potassium ferrocyanide, and it was noticed that the translocation takes place essentially in the phloem, although in the ringbarked region it is first taken up by the xylem. Only after about eight days does the xylem show copper in the same degree as the phloem does after twenty-four hours.

In my laboratory experiments, I used the following method. A ringbarked young twig was pushed down

the stem of a glass funnel so that it emerged about 1 cm. at the lower end. This part was dipped into water. The ringbarked region was so arranged that it was situated in the conical part of the funnel. This region was then covered with a mixture of calcium chloride, copper sulphate and soil all finely powdered and mixed. The soil is necessary to prevent the formation of a hard cake; it seems also to induce rapid absorption, for without it the transport of copper is much slower. Results are obtained after twenty-four hours. The translocation in cut twigs is, however, far slower than in branches attached to the main stem, where a transpiration stream passes through them.

I have also tested the method on two species of *Acacia*, on *Burkea Africana* and *Ochna pulchra* ringbarked near the crown; in all cases I obtained a rapid movement of copper into the leaves.

These experiments were carried out with the sole object of finding a suitable method for eradication. The method has given very satisfactory results with *Dichapetalum cymosum*. The technique could, however, also be used for the study of the translocation of solutes as such. Instead of a toxic substance, sugars, nitrogen compounds, phosphates, etc., could be added to the mixture of calcium chloride and soil, and the different regions of the branch then could be analysed to establish the main path of translocation. Even if the calcium chloride reacts with some of the substances to be used (as it does with copper sulphate) the experiment will not be disturbed.

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A. C. LÉEMANN  
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#### Differentiation of Varieties of Eucalypts by their Essential Oils

In continuation of our investigations into the occurrence of varieties of well-known species of eucalypts, *E. dives* and *E. radiata* (*E. numerosa*), *E. australiana*, etc., as determined by chemical analyses of the essential oils, we have made an interesting observation with *E. radiata* variety "A" which is considered worthy of early mention.

The occurrence of a number of varieties of *E. radiata* (*E. numerosa*) was investigated in 1930<sup>1</sup>. Young trees of the type and its varieties were raised from seed and the essential oils afterwards examined. These were found to be quite constant, with the exception of one tree of variety "A" which threw out two stems, each about 20 ft. in height, from the one root system. The leaves and terminal branchlets of each stem were examined separately and, to our surprise, they yielded different essential oils, one giving an oil indicative of variety "A" whilst the other was almost identical with what we prefer to regard as the type species. We are unacquainted with any record of a similar observation.

This observation provides additional evidence in support of our previous contention that the theory of the constancy of species, based upon the chemical composition of the essential oils, does not hold in every instance.

Full details of this investigation will be published in the *Journal and Proceedings of the Royal Society of New South Wales* for 1936.

Technological Museum,  
Sydney.  
Oct. 14.

A. R. PENFOLD.  
F. MORRISON.

<sup>1</sup> *J. Proc. Roy. Soc. New South Wales*, 66, 181 (1932).



Colour in the Dogfish, *Scyllium canicula*

SINCE the completion of a paper on colour change in the dogfish<sup>1</sup>, two points of interest have arisen. The first concerns the colour cells and their natural responses in the young fish, and the second one concerns melanophore control in the various members of the group Elasmobranchii.

The colour cells of a young dogfish (*S. canicula*) hatched in the Zoology Department at Liverpool were investigated, and observations made on the natural responses of the melanophores. There proved to be four types of colour cells, only three of which have been described from the adult<sup>1</sup>. The natural melanophore responses to illuminated dark and light backgrounds were the same as in the adult fish<sup>1</sup>.

In the newly hatched fish, focusing from the lower skin levels to the surface on the pectoral fin, there appear in order very conspicuous deep yellow cells capable of completely rounding off and of expansion to a stellate condition, greyish brown cells never seen in the contracted state but always with blunt irregular branches, light brown melanophores and finally, dark superficial melanophores. The yellow cells are numerous and very conspicuous, whereas in the adult they are very few and frequently cannot be found at all. The greyish brown type of cell has not previously been described from either the young<sup>2</sup> or adult<sup>1</sup> fish. The pigment from both these latter cells was dissolved out in alcohol. The two types of melanophore are exactly similar to those described from the adult fish<sup>1</sup>.

Although on some occasions no melanophore response could be obtained, as a rule on an illuminated white background and in complete darkness the melanophores contracted, while on an illuminated black background they expanded. The melanophore response to illuminated dark and light backgrounds is, therefore, the same as in the adult<sup>1</sup>, and the same as in the young<sup>3</sup> and adult<sup>4</sup> of *Mustelus*. The response to complete darkness is not known for the adult *Scyllium* or for the young or adult of *Mustelus*. The changes of the yellow cells and of the greyish brown cells have not been studied and the ultimate fate of the latter is not known. Unfortunately, the fish died.

The observations recently made by Parker on the colour change mechanism of *Raja erinacea*<sup>5</sup> and *Squalus acanthias*<sup>6</sup> direct attention afresh to the possibility of a lack of uniformity in the mechanism of colour control among the Elasmobranchii.

In all Elasmobranchs so far investigated<sup>1,7,8</sup> it is established that the normal dark background reaction (dark skin, expanded melanophores) is due to the activity of neuro-intermediate lobe of the pituitary. Where more detailed information is available, it is clear that the neuro-intermediate lobe exerts its influence by means of a blood-circulated hormone<sup>1,9</sup>.

Regarding the mechanism of the natural light background reaction (contracted melanophores), however, there is no uniformity of opinion. In *Mustelus canis*, Parker and Porter<sup>10</sup> and Parker<sup>11</sup> have described and figured paling effects in dark fins as a result of faradic stimulus and of cuts made transverse to the fin rays. These effects have been interpreted by them as showing that the natural paling response in this fish is due to direct nervous action on the melanophores. On the other hand, cuts made by me<sup>12</sup> in the fin of a dark *Scyllium canicula* failed to give any paling effects, and severance of selected nerves by Young<sup>13</sup> in *Scyllium* sp. and by Wykes<sup>14</sup> in *Scyllium canicula*, *Raja brachyura* and *Raja maculata* did not influence the melanophore condition or, in the latter cases<sup>14</sup>, the melanophore response in the area supplied by

these nerves. Further, electrical stimulation of nerves<sup>14</sup> in *Raja brachyura*, *Rhina squatina* and *Scyllium catulus* did not result in any melanophore changes. From these negative results it has been concluded that there is no direct nervous control of melanophores in these fish.

In *Scyllium canicula*<sup>1</sup>, *Raja maculata* and *Raja brachyura*<sup>7</sup> removal of the anterior lobe of the pituitary alone destroys the natural light background reaction, and from this it has been concluded that the natural paling response of these fish is in some way connected with the activity of the anterior lobe. The effect of removal of the anterior lobe alone on the light background response of *Mustelus canis* unfortunately has not been described.

The above facts have led me to suggest<sup>15</sup> that in the various members of Elasmobranchii there may be found different methods of melanophore control. This suggestion has now received considerable support from the observations of Parker himself that cuts made in the fins elicit no paling response whatsoever in *Raja erinacea*<sup>5</sup> and only a very uncertain response in *Squalus acanthias*<sup>6</sup>.

Zoology Department,  
University,  
Liverpool.  
Dec. 4.

H. WARING.

<sup>1</sup> Waring, *Trans. Liv. Biol. Soc.*, **49**, 59 (1936).

<sup>2</sup> Ford, *J. Mar. Biol. Assoc. Plymouth*, **12**, 501 (1921).

<sup>3</sup> Parker, *Biol. Bull. Woods Hole*, **70**, 3 (1936).

<sup>4</sup> Parker and Porter, *ibid.*, **66**, 31 (1934).

<sup>5</sup> Parker, *ibid.*, **71**, 258 (1936).

<sup>6</sup> Parker, *Proc. Nat. Acad. Sci.*, **22**, 60 (1936).

<sup>7</sup> Hogben, *Proc. Roy. Soc., B*, **120**, 157 (1936).

<sup>8</sup> Lundstrom and Bard, *Biol. Bull. Woods Hole*, **62**, 8 (1932).

<sup>9</sup> Parker and Porter, *ibid.*, **66**, 34 (1934).

<sup>10</sup> Parker and Porter, *ibid.*, **66**, 32 (1934).

<sup>11</sup> Parker, *ibid.*, **68**, 3 (1935).

<sup>12</sup> Waring, *Trans. Liv. Biol. Soc.*, **49**, 50 (1936).

<sup>13</sup> Young, *Quart. J. Micro. Sci.*, **75**, 580 (1933).

<sup>14</sup> Wykes, *J. Expt. Biol.*, **13**, 465 (1936).

<sup>15</sup> Waring, *Trans. Liv. Biol. Soc.*, **49**, 58 (1936).

## The 'Specific Action' of Ultra-Short Wireless Waves

WE have received a letter from Prof. W. Szymanowski, of the Institute for Physiological Research at Moscow, in which he makes certain comments on our article on the above subject which recently appeared in NATURE<sup>1</sup>. We should like to be allowed to summarize these and to reply to them as briefly as possible.

(1) Prof. Szymanowski points out that his work with Dr. Hicks on the action of short waves on toxins and bacteria was begun, and a first note published<sup>2</sup> in 1930, before the corresponding work by Haase and Schliephake<sup>3</sup> (published 1931), so that our reference to the former work as confirmatory of the latter was likely to create a false impression in regard to priority. We admit the justice of this criticism, and tender our apologies to Prof. Szymanowski.

(2) In referring to two papers by Szymanowski and Hicks<sup>4,5</sup>, dealing with the action of ultra-short waves on various bacteria, toxins, etc., we stated that in the second paper they withdrew their earlier results on toxin. Prof. Szymanowski takes exception to this statement, and makes it clear that no such withdrawal was intended. We accept his correction, and would merely remark that our impression was perhaps excusable in view of the general tone of the second paper, which, in contrast to the first, was mainly devoted to the presentation of negative evidence relating to the "specific effect", and included the sentence (p. 471): "The meagre character, however, of the action on diphtheria toxin and the delicacy of the conditions under which it may be



detected in any degree make it a phenomenon of relative insignificance in the interpretation of clinical or other studies of H.F. currents". Further, the authors state in conclusion (p. 472): "It is possible, however, to say from the work now reported, that at least there is no biologic action on the substances mentioned under the described conditions of exposure to ultra-high frequency field". We understand that Prof. Szymanowski did not mean to cast doubt on the reliability of the results in question, and are in full agreement with him that further investigation of these interesting effects is very desirable.

(3) Prof. Szymanowski further directs our attention to an interesting fact which had escaped our notice, namely, that in 1896 D'Arsonval and Charrin reported attenuation of diphtheria toxin by radiation of frequency  $2 \times 10^5$  cycles per second, also without any dangerous temperature elevation. It is thus possible that such effects may be associated with high-frequency currents in general, rather than with ultra-short waves only.

(4) Prof. Szymanowski agrees with us that the overwhelming majority of the facts are consistent with a purely thermal explanation of the effects, and adduces some further evidence. For example, he has found<sup>6</sup>, in a study of the lethal time of mice, an almost exact parallelism with the law of heating of electrolytes at these frequencies, and similar results, on *Drosophila*, were afterwards obtained by Malov<sup>7</sup>. Further, in work not yet published, he has shown that Pflomm and Liebesney's effect on the heart-beat of the frog, previously claimed as a clear case of a 'specific' effect, can be almost exactly reproduced by a very slow temperature elevation. We may mention that Hill and Taylor<sup>8</sup> have also shown that this effect is thermal in origin.

Prof. Szymanowski concludes by remarking that in spite of the meagreness of the positive evidence at the present time, it seems worth while to continue to look for it "by impartial and well controlled investigations". With this we entirely concur. The primary purpose of our article was to direct attention to the fact that scarcely any of the experimental work on which belief in specific effects has been based has satisfied both these conditions.

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W. E. CURTIS.  
F. DICKENS.  
S. F. EVANS.

<sup>1</sup> Curtis, Dickens and Evans, *NATURE*, **138**, 63 (1936).

<sup>2</sup> Szymanowski and Hicks, *Science*, **72**, 174 (1930).

<sup>3</sup> Haase and Schliephake, *Strahlentherapie*, **40**, 134 (1931).

<sup>4</sup> Szymanowski and Hicks, *J. Infect. Diseases*, **50**, 1 (1932).

<sup>5</sup> Hicks and Szymanowski, *J. Infect. Diseases*, **50**, 466 (1932).

<sup>6</sup> Szymanowski, *Bull. Acad. Polonaise*, **B**, 217 (1933).

<sup>7</sup> Malov, *Strahlentherapie*, **53**, 326 (1935).

<sup>8</sup> Sir Leonard Hill and Taylor, *Lancet*, 311 (Feb. 8, 1936).

### The Half-Drill Strip System Agricultural Experiments

"STUDENT'S" letter in *NATURE* of December 5 shows that he has overlooked the purpose of the paper he criticizes, although it was set out in the first sentence of the summary as follows:

"This enquiry was carried out to test the truth of the opinion expressed by 'Student' that randomization achieves its object 'usually at the expense of increasing the variability when compared with balanced arrangements', and that one of the means available to experimenters of reducing the error is by adopting 'a regular balanced arrangement'."

The quotations in this sentence are from "Student's" paper "Co-operation in Large-Scale Experiments", read before the Royal Statistical Society.

"Student" does not deny that the arrangement examined, and found to be extremely misleading, is, in fact, "a regular balanced arrangement". He even tells us that the method of calculating the error was that formerly used for half-drill strip experiments; though following his, "Student's", criticisms in 1923, "it has been customary" to use other methods of calculation for estimating the error.

It is not noticed, apparently, by "Student" that Dr. Barbacki and I criticize systematic arrangements in general on the ground that "the experimenter has an arbitrary choice between several widely different estimates". The two we show to be misleading correspond with the two random arrangements which we also test.

"Student" writes: "Had Prof. Fisher and Dr. Barbacki calculated the error on that basis" [as now advocated by "Student"] "they would have found a standard error of 2.37 per cent". This, then, it appears, is the standard error which "Student" thinks is appropriate for the systematic design discussed; yet we find that, on the same land, a random arrangement gives a standard error of less than 0.7 per cent. If "Student's" estimate is right, the randomized experiment is worth as much as the average of eleven such systematic experiments. This is, of course, a different ground of criticism from that on which I have habitually advocated randomization, for I cannot think that "Student's" new estimate is less arbitrary than the others. However, on his own result, what becomes of the claim that randomization tends to *increase* the error, or that experimenters can usefully try to diminish it by adopting regular balanced arrangements?

R. A. FISHER.

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Dec. 4.

### Hypoglycæmic Action of Histone Insulinate

By mixing a solution of thymus histone with another of crystalline insulin, at pH 7-7.2, a precipitate is produced containing most of the insulin previously present in solution.

When administered to normal or pancreatectomized dogs, the histone insulinate gives a more prolonged hypoglycæmia than the pure crystalline insulin. The level and duration of this hypoglycæmia are practically identical with that obtained by injection of the same amount of protamine (clupein) insulinate, prepared also from crystalline insulin<sup>1</sup>.

As this crystalline insulin contains zinc, it is not improbable that this metal has a favourable influence in the prolongation of the hypoglycæmia, specially in view of the experiments of Fisher and Scott<sup>2</sup>.

The detailed account of this work will be published in full shortly.

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VENANCIO DEULOFEU.  
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Dec. 2.

<sup>1</sup> Jensen Hagedorn *et al.*, *J. Amer. Med. Assoc.*, **106**, 177 (1936).

<sup>2</sup> *J. Pharm. Exp. Therap.*, **58**, 78 and 93 (1936).



### Latent Heat of Evaporation of Liquid Helium

EARLY last year<sup>1</sup>, Prof. E. F. Burton gave the results obtained by Messrs. Wilhelm and co-workers for the viscosity of liquid helium at three temperatures, attention being directed to the marked change as HeI is transformed into HeII.

The data, however, possess a further interest. In 1934, I showed that the molar latent heat of evaporation,  $L$ , can be calculated, with the aid of an equation similar to the Clausius-Clapeyron equation, from viscosity data at temperatures near the boiling point<sup>2</sup>. The equation is:

$$L = 9.2 R \frac{T_1 T_2}{T_2 - T_1} \log_{10} \eta_1 / \eta_2,$$

where  $R$  is the gas constant (1.985) and  $\eta_1$ ,  $\eta_2$  are the viscosities at the absolute temperatures  $T_1$  and  $T_2$ .

Taking Burton's values, namely,  $\eta_1 = 27 \times 10^{-5}$  at  $2.3^\circ$  K. and  $\eta_2 = 11 \times 10^{-5}$  at  $4.2^\circ$  K., we find:

$$L = 36.2.$$

If now we calculate  $L$  with the aid of the Clausius-Clapeyron equation using the data of Onnes, as given by Mellor in his "Comprehensive Treatise, etc.", namely,  $p_1 = 760$  mm. at  $-268.71^\circ$  C. and  $p_2 = 565$  mm. at  $-269.03^\circ$  C., we find,

$$L = 31.3.$$

As this latter temperature range is slightly higher than the former, a somewhat smaller value for  $L$  is to be expected than in the first calculation. Bearing this in mind, and remembering also the extreme experimental difficulty in carrying out measurements with liquid helium, the close agreement between the two values of  $L$  is remarkable.

J. NEWTON FRIEND.

Technical College,  
Birmingham.

Nov. 20.

<sup>1</sup> NATURE, 135, 265 (1935).

<sup>2</sup> Trans. Far. Soc., 31, 542 (1935).

### Points from Foregoing Letters

THE isotopic weights and 'packing fractions' for atoms of silicon (mass 28), phosphorus (31), sulphur (32) and chlorine (35 and 37) have been obtained by Dr. F. W. Aston with his 'second-order focusing' mass-spectrograph, by comparing doublets (atoms and groups of atoms having the same mass/charge ratio). Dr. Aston directs attention to an unexplained discrepancy between his results in the case of the  $O, CH_4$  doublet and those of Bainbridge and Jordan.

A curve showing the absorption, in different thicknesses of boron, of the neutrons which produce gamma-ray activity in silver, is submitted by E. H. S. Burhop, R. D. Hill and A. A. Townsend. This curve indicates the presence of two components (with absorption coefficients of 8.1 and 0.24 gm.<sup>-1</sup> cm.<sup>2</sup> respectively) and differs from the curves obtained from the absorption of neutrons which excite the 22- and 138-second activities in silver. The authors suggest that the nucleus may possess two systems of energy levels, corresponding to the emission of electrons and of gamma radiation respectively.

By irradiating silver with neutrons, first directly and then through a paraffin screen, Prof. G. Guében finds that three radioactive substances of half-life 50, 30 and 150 seconds, approximately, are produced. Apparently the first, which may be rhodium of mass 104, is produced by fast neutrons, the second by slow neutrons and the third by both fast and slow neutrons. Previous investigators have reported activities of 22, 26, 40, 138 and 154 seconds.

A simplified procedure for determining accurately the boiling point of a liquid (by the comparative method of Świątosławski) is described by Dr. M. Wojciechowski. If the pressure cannot be adjusted exactly to one atmosphere, a second pair of observations is made at a pressure only slightly different, so that the variation of the boiling point with respect to pressure can be assumed to be linear, and the necessary correction can then be made.

Depolarization factors of 0.10 and 0.17 have been obtained for the 3019.0 and 1343.9 Raman lines respectively in ethylene gas by S. Bhagavantam. This

high degree of polarization is in accord with the origin of these lines. In the Raman spectrum of this gas, besides the intense lines, two weak lines which do not correspond to fundamentals but which were obtained by Bonner in the liquid have also been recorded.

M. Nicolet directs attention to the fact that from the numerous values recently proposed for the heat of dissociation of carbon monoxide, only the value  $D(CO) = 9.1$  e.v. is in good agreement with theoretical and observational knowledge of the composition of the atmospheres of late-type stars.

The hydrogenation-reduction of vitamin  $B_1$  by platinum-black and by hydrosulphite is described by F. Lipmann. The author formulates the reaction on the assumption that the reduction takes place at the double bond closest to the nitrogen atom with four valency bonds.

That chlorophyll (ethyl chlorophyllide) is reversibly oxidized by ferric chloride with change in colour to greenish-yellow and quenching of fluorescence is shown by experiments carried out by Drs. E. Rabinowitch and J. Weiss. They find that the oxidation is greatly favoured by illumination, which is important in view of the part played by chlorophyll in photosynthesis.

The behaviour of the coloured cells in a young dog-fish, under illumination, is described by H. Waring, who finds four types of cells as against three types described in the adult fish. The author considers that in some fishes (sharks, rays, etc.) there is no direct control of the colour cells but that the 'paling' effect is in some way connected with the activity of the anterior lobe of the pituitary gland.

ERRATUM. In the second paragraph under this heading in NATURE of December 5, p. 976, for "From the interchangeability of lactic dehydrogenase from heart muscle with alcohol dehydrogenase . . ." read "From the interchangeability of lactic co-dehydrogenase from heart muscle with alcohol co-dehydrogenase from yeast . . ."



## Research Items

### Maternal Mortality and Malnutrition

THE causes of maternal mortality are many. Sepsis still occurs, though it is subdued, and is now low compared with "other causes", among which malnutrition appears to be important. This is the conclusion that emerges from recent investigations which are described in an article by Lady (Rhys) Williams in the October number of *Public Health*. The practical work described was begun in the Rhondda Valley, a distressed area, on January 1, 1934. In spite of increased ante-natal care and medical supervision, the puerperal death-rate there rose to 11.29 per 1,000 total births. In 1935, expectant and nursing mothers were provided with extra foodstuffs, tinned and bottled but protective, and one pint of milk a day, with the result that not a single mother, who had received the extra food, died. The feeding scheme was extended to include five adjoining towns of a similar type. Up to June 30, 1936, the puerperal rate had fallen to 5.46 in the Rhondda, and 3.75 in the new areas, as compared with the previous eight-year averages of 7.72 and 6.65, respectively; and the puerperal rate fell much more than the sepsis rate. Numerous graphs are reproduced which show a striking correspondence between the puerperal and the infantile death-rates when the latter relate to the preceding year. The divergence of the rates for the same year and their correspondence for successive years is explicable in terms of nutrition, and it is pointed out that these rates would have been affected simultaneously had climate or epidemics been the cause. Stronger evidence that malnutrition is an important cause of maternal and neo-natal mortality is afforded by the much higher average levels of the death-rate in distressed, as compared with prosperous, areas; and it is shown that the differences cannot be ascribed to climate or, to any extent, to bad housing (see also *NATURE*, 137, 529; 1936).

### Tripolje Settlement in Kiev Province

SOVIET archæologists of the Marr Academy of Material Culture, excavating near the village of Khalepye in the province of Kiev, it is reported by the Soviet Union Year Book Press Service, have brought to light a settlement belonging to the Tripolje culture. The settlement was circular in plan, enclosed by a single row of houses, with doors opening on the enclosed space, the whole resembling a fort, into which the domestic animals were driven at night for protection. The houses were built of clay, and were about twenty metres long. The baked clay of the floors, and remains of stoves, walls and fences were found in an excellent state of preservation. The stoves and walls in some of the houses had been coloured with red ochre. The chief occupations of the inhabitants of the settlement were agriculture and cattle-breeding; but there is evidence that hunting had been an auxiliary means of livelihood. Many stone grinders and agricultural implements made of horn were found inside the houses: One hundred earthenware utensils ranged in size from very small

receptacles of not more than two centimetres high to vessels seventy centimetres high. Thirty statuettes were found, some of which are unique. They give an idea of the dress of both men and women of the settlement. The women wore their hair loose, but tied in a knot at the ends, while an indispensable article of their attire was a girdle, the ends of which hung down at the side. The men are shown as wearing a garment draped across the shoulder. The excavations are to be continued next season.

### Visual Acuity and Speed of Vision in Road Lighting

IN observing objects on artificially illuminated highways the first requirement is to perceive the presence of the object. This is rendered possible by the contrast between the object and the road surface. The nature of the contrast and the sensibility of the eye are the determining factors. When the object has been perceived, it is necessary to see its exact form and estimate its distance. This is governed by the visual acuity of the eye. It is customary to take the angle of vision at which two parallel lines are still just perceptible as separate entities. It is better to take the reciprocal of this angle (expressed in minutes), so that the larger number gives the greater visual acuity. Another method is to give the distance at which a circle with a diameter of 1 cm. and a square with a diagonal of 1 cm. can still just be differentiated. In addition to visual acuity, the speed of vision is also an important factor. In the *Philips Technical Review* (Eindhoven) of July, the relationship is investigated, by P. J. Bouma, between the visual acuity and the brightness levels of the object and the background. The difference also between the type of illumination and distance of observer from object is examined. Close investigation shows that all monochromatic colours, with the exception of blue and violet, give a greater visual acuity than white light. The low visual acuity for blue light is partly due to the fact that the eye is myopic for this short wave-length. With technical sources of light, the visual acuity is considerably greater with sodium and mercury light than with ordinary glow lamp and neon light. The author investigates the speed of vision for various types of light. For stationary objects, mercury and sodium lamps are better than glow lamps and neon light; but for moving objects sodium light is the best, then glow lamps and finally mercury light.

### Sheep and Wool Production in North-Eastern Asia

THE total sheep population of China, Inner Mongolia and Manchukuo is round about 30,000,000, mostly run under nomadic conditions and carrying a low wool crop averaging only about 2.6 lb. a head. I. Clunies Ross points out (*Pamphlet No. 65, Council for Sci. Ind. Research, Australia: Melbourne, 1936*) that improved wool production by crossing between native and merino sheep is difficult because of climatic conditions and the effect particularly of the severe winter upon pastures, and would entail



housing and hand-feeding during six months of the year. In Japan, sheep-rearing is not likely to become a major industry, but the movement of the Japanese and Chinese markets from cotton and silk to woollen materials indicates a prospect of further demand for wool, and since both nations are developing their own woollen factories, the demand will be of direct benefit to the export from Australia of raw wool, from which the imported tops are manufactured.

#### Prosobranchs of the North Sea and Baltic

DR. W. E. ANKEL has contributed an excellent monograph on the gastropods ("Die Tierwelt der Nord- und Ostsee" (Lief. 29, Teil 9, b, "Prosobranchia", von W. E. Ankel. Pp. 240. Leipzig: Akademische Verlagsgesellschaft m.b.H., 1936). Although it deals only (except in a few cases) with the species occurring in the North Sea and Baltic, there are so many of these which are common on all the coasts of Britain that it is practically a text-book of the prosobranchs of our seas, and the general matter applies to all. The author has himself worked specially on the reproduction and reproductive organs of these molluscs, but the clear original drawings scattered about the work show that he is a true naturalist in every sense of the word. Many of these figures are of the live animals, showing them crawling, burrowing, feeding, and are of distinction and quality. Besides bringing together a large amount of work by other authors showing a thoroughly up-to-date knowledge of the subject, this monograph contains much original matter. It is refreshing to find here so much that is really new. The life histories of most of our common prosobranchs are now known, and we have a fair idea of their egg-laying habits and development, but these descriptions are scattered far and wide. This is the first time that an attempt has been made to bring them together, and we gradually come nearer to the ideal work in which the description of every species shall be accompanied by notes on its life-history, and not only adult characters shall be used in classification, but also those of the embryonic and larval forms.

#### Japanese Diatoms

DR. H. AIKAWA has contributed an extensive paper "On the Diatom Communities in the Waters Surrounding Japan" in vol. 8, No. 1 of the Records of Oceanographical Works in Japan compiled by the Committee of Pacific Oceanography of the National Research Council of Japan. All plankton samples collected by the research ships of the prefectural fisheries experimental stations along the coast of Japan are submitted to the Imperial Fisheries Experimental Station, Tokyo, and the author has studied these in detail both quantitatively and qualitatively. The number of individuals of different species is counted in a sample by Hensen's method, and the respective percentages of animal and plant plankton worked out. The work is mainly concerned, however, with diatoms, and diatom communities are described from the waters around the West Aleutian Islands, Okhotsk Sea, the Tôhoku region, Tokyo Bay, Sagami Bay, Suruga Bay, the southern Pacific coast, the tropical regions and in the Japan Sea with Wakasa Bay and Tyôsen Strait. Both cold and warm currents flow around Japan. Enormous mass-production is found in cold waters, the warm water regions being richer in species. Seasonal succession

is very noticeable in the neritic regions whilst the oceanic plankton is remarkably uniform. A list of forty of the principal diatom species shows many that are common in British waters.

#### Spiders of Lahore

A COMPREHENSIVE paper on the spiders of Lahore, by Mr. Sukh Dyal, has been issued (*Bull. Dept. Zoo., Punjab University*, 1, 119-252). This work forms the fourth of a series entitled "Fauna of Lahore", published by the Punjab University. Altogether, 121 species are enumerated and are comprised in 60 genera and 20 families: of these, 46 species were previously undescribed. The majority of the spiders of the district appear to be web-spinners of arboreal habits, and among them are instanced several remarkable examples of protective coloration. The paper is provided with keys to the families, genera and species dealt with, and the text is illustrated with a number of well-executed plates showing diagnostic structural characters. At the end of the text, a rather extensive glossary of the terms employed is given, together with a list of relevant papers and memoirs.

#### Origin of Rice

MUCH progress is now being made in connexion with the cytology and genetics of rice. The chromosome number is  $2n = 24$  in all varieties of *Oryza sativa* examined, although haploids with 12 chromosomes frequently occur. Dr. H. K. Nandi has brought forward (*J. Genetics*, 33, No. 2) results of much interest to show that the genus *Oryza* is a secondary polyploid derived from a previous basic number of 5, and Mr. S. Ramanujam has found that the related *Zizania aquatica* has  $2n = 30$  and is therefore probably a hexaploid based on 5. In the pollen mother cells of rice varieties Dr. Nandi finds two pairs of satellited chromosomes of unequal length attached to the nucleolus, and very clear secondary pairing of the chromosomes in the metaphase of both meiotic divisions. The maximum pairing gives three groups of two and two groups of three bivalents, thus indicating that 5 was the primary chromosome number in *Oryza*. Haploids also occasionally show two bivalents. It thus appears that the genus *Oryza* originated as an allotetraploid through hybridization between two different ancestral species having  $2n = 10$  chromosomes. Due to meiotic irregularities in the hybrid, two chromosomes were probably duplicated, and subsequent chromosome doubling produced a stable type with  $2n = 24$ . The conclusion is reached that on the basis of present evidence it cannot be determined whether the cultivation of rice began in China, India or Africa.

#### Heat-Treatment for Wood-Decaying Fungi

A SHORT paper by Mr. H. B. S. Montgomery (*Trans. Brit. Mycol. Soc.*, 20, pts. 3 and 4, Nov. 1936) gives the results of some experiments upon the lethal temperatures for a number of common wood-decaying fungi. Four species of the genus *Lenzites*, *Merulius lacrymans* (dry-rot fungus), *Poria vaporaria*, *Pholiota adiposa*, *Polyporus hispidus*, *Schizophyllum commune*, *Fomes fraxineus* and *Lintinus lepideus* have been studied. Temperatures which destroy each species are set forth in tabular form, and *Lenzites lepideus*, the most resistant of the fungi tested, was killed by



treatment for 60 min. at 65° C. The experiments are on a laboratory scale, but they would provide a basis for the practical treatment of ornamental carving, or other small pieces of valuable timber when a rotting fungus appears.

#### A Fungal Parasite of Algæ

A SHORT paper by Mr. D. J. Scourfield, in the *Essex Naturalist* (25, Pt. 3, April-Sept. 1936) describes a fungus parasitic upon the alga *Chlorogonium elongatum*. The host is only about a tenth of a millimetre in length, and the fungus is less than a thousandth of a millimetre in diameter. Ciliated zoospores are formed by the latter organism, and these organs come to rest upon the surface of a *Chlorogonium* individual, which is ultimately parasitized by the entrance of a hypha-like outgrowth from the fungus. *Phlyctidium chlorogonii* Serbinow is the name of the fungus; it belongs to the Chytridiales, and is now described as a British species for the first time.

#### The North Sea Basin

DR. DUDLEY STAMP has attempted the difficult task of tracing the physical development of the North Sea basin since Miocene times (*J. Con. Intern. pour l'exploration de la Mer*, 11, No. 2; 1936). Before that time, the problem is less involved and the history of the Germano-British sea can be traced from Carboniferous to Miocene times. The Alpine storms of Miocene times restricted this sea. In Lower Pliocene times the sea invaded the London Basin syncline and there was probably a strait to the west, either through the London basin or by a synclinal trough farther south. In later Pliocene times this connexion was severed. The shallow North Sea persisted until the period after the third British glaciation, but during the second glaciation it was narrowed by the Scandinavian ice to an ice-front lake overflowing to the English Channel. The present flow of the North Sea is essentially the submerged landscape of the period subsequent to the third glaciation, though the sediments have been partly resorted by current action. The land phase ended with the Pleistocene and beginning of the Holocene period. Then the connexion between the North Sea and the English Channel was made. In the Post-glacial period the Straits of Dover were open but shallow and narrow, and then set in a transgression of the North Sea waters, and with the opening of the Strait, tidal currents became marked and coast erosion and coastal accumulation begun. Dr. Stamp's reconstruction, which he admits is tentative, is illustrated by numerous maps.

#### Specific Heats of Metals

THE October issue of the *Canadian Journal of Research* contains two communications from Prof. H. L. Bronson and his colleagues of Dalhousie University describing their determinations of the specific heats of nearly pure specimens of silver, nickel, zinc, cadmium and lead between -80° C. and 120° C., and of silver and nickel between 100° C. and 500° C. For the lower temperatures, cylinders of between one and two kilograms, electrically heated in a heavy copper enclosure, were used; for the higher, cylinders of about 10 gm. heated in an electric furnace and dropped into a water calorimeter. The values found cannot be represented correctly to within about one

per cent by the Debye function of a temperature characteristic for each metal, but for the low temperatures require in addition a term proportional to a power of the absolute temperature, and for the higher a further term for temperatures above 250° C. in the case of nickel. The characteristic temperatures and powers of the absolute temperature are respectively for silver 220°, 1.16; nickel 372°, 5/3; zinc 235°, 3/2; cadmium 160°, 5/3; lead 88°, 1.38.

#### Helium produced in Artificial Transmutation

F. A. PANETH, E. Glückauf and H. Loleit (*Proc. Roy. Soc., A*, 157, 412) have for the first time detected a product of artificial transmutation by ordinary chemical methods. Boron, in the form of the volatile ester methyl borate, was exposed to slow neutron bombardment in a copper vessel. The helium was boiled out and purified by chemical methods and by cooled charcoal. The volume of the helium was measured in the capillary tube of a Pirani gauge. The presence of atmospheric helium was checked by a spectroscopic determination of neon in the helium. The amount of helium produced by the neutrons from 2 curies of radon during its decay is about  $2.4 \times 10^{-7}$  c.c. (see also *NATURE*, 136, 950; 1935).

#### The Identity of Comets 1818 i, 1873 vii, 1928 iii

IN *Astr. Nach.*, 261, 6245, there is a very interesting article by Dr. A. C. D. Crommelin which shows that Prof. Kobold and Miss Vinter Hansen were incorrect (*Astr. Nach.*, 260, 6226) in placing Comet 1928 iii among the non-periodic comets. Dr. Crommelin gives three independent lines of proof which establish the connexion. The first evidence is found in the fact that the elements derived from the apparitions of 1873 and 1928, when reduced to a common epoch, are practically identical, as shown by Dr. Crommelin's article in *Mon. Not. Roy. Astro. Soc.*, 89, 556 (April 1929). An interesting comparison is shown between the elements of Comet 1873 vii and 1928 iii, the differences in  $\omega$ ,  $\Omega$  and  $i$  being -13.7', -26.2' and +6.8' respectively, and his computations on the perturbations of the four larger planets show that the changes are -9.5', -30.5' and +5.6', an agreement which certainly cannot be merely fortuitous. The second line of evidence is found in the fact that when Dr. Crommelin used an arc of nearly two months available observations in 1928, he found a period of 27.90058 years, and there was a close agreement between this and the period in 1928 derived from the perturbations between 1873 and 1928, which was 27.8969 years. The third evidence, which seems the most important, is found in the close agreement between the two periods in 1873 derived from the 1818-73 arc with perturbations and from the 1873-1928 arc with perturbations. It is true that Dr. Crommelin admitted a discordance of 13 days in his paper in *Monthly Notices*; but he has revised the work, using shorter time-intervals and including the inner planets. The result is almost perfect agreement, a difference of only 1.818 days existing. Prof. Kobold saw a proof of this article before publication and has admitted the validity of Dr. Crommelin's contention regarding the identity of the comets. His offer to include them under the title of "Crommelin's Comet" is a sign of his appreciation of the work of the director of the Comet Section of the British Astronomical Association.



## High Voltage X-Ray Therapy

THE formal opening of the Mozelle Sassoon High Voltage X-Ray Therapy Department of St. Bartholomew's Hospital, London, took place on December 10. This splendid department owes its existence to the far-seeing generosity of Mrs. Meyer Sassoon, who gave the considerable sum of money required for its erection and equipment. It has been established with the object of promoting the relief and cure of cancer by the application of the most recent developments in physical science.

There are three main limitations to the effectiveness of present-day technique in radiation therapy: the difficulty of the delivery of an adequate dose of radiation to a tumour or site deep in the body, without damage to overlying structures; the difficulty of giving this dose within a reasonably short exposure time; and the narrow margin of safety, due to the small difference in radiosensitivity, between normal and malignant tissues. The first of these can be overcome by means of a sufficiently penetrating radiation; the second by the use of high intensities of radiation; while differences in radiosensitivity depend in part upon the wave-length of the radiation employed.

The new installation is designed to give a beam of X-rays of greater penetrative power, of higher intensity, and of shorter mean wave-length, than any so far employed in the treatment of cancer. Furthermore, since the apparatus may be operated at any voltage from 250,000 volts up to 1,000,000 volts, its range and flexibility will permit the choice of the optimum conditions of treatment which may be found applicable in different cases.

Side by side with this work will proceed the investigation of the physical, chemical, and bio-

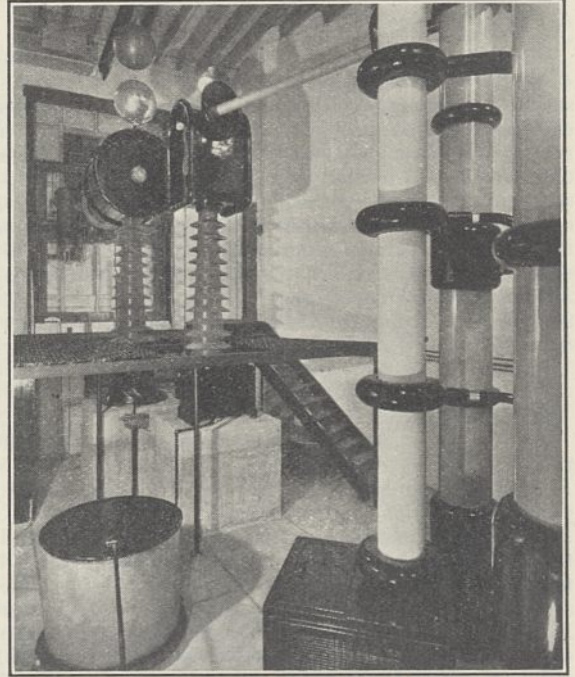


FIG. 2. Generating equipment. Positive end.

logical effects of X-rays generated at high voltages, and the therapeutic application of the results obtained.

### THE X-RAY TUBE

The X-ray tube is the dominant feature of the Department, and embodies many noteworthy details, both of design and construction. It is thirty feet long, and weighs ten tons. It consists essentially of an inner continuously-evacuated steel tube containing the filament and target. This tube is supported at each end by a porcelain insulator, and extends horizontally from one generator room to the other across the treatment room (Fig. 1). The portion within the treatment room, that is, the central twelve feet, is surrounded by a protective sheath, consisting of a six-inch layer of 'close-packed' lead shot, enclosed between two coaxial steel cylinders. An aperture in this sheath allows the transmission of the X-ray beam. The protective sheath, in its turn, is surrounded by a steel cylinder, which carries the filters, diaphragms, and applicators for defining the X-ray beam. The protective sheath and applicator cylinder can be rotated independently of each other, by means of

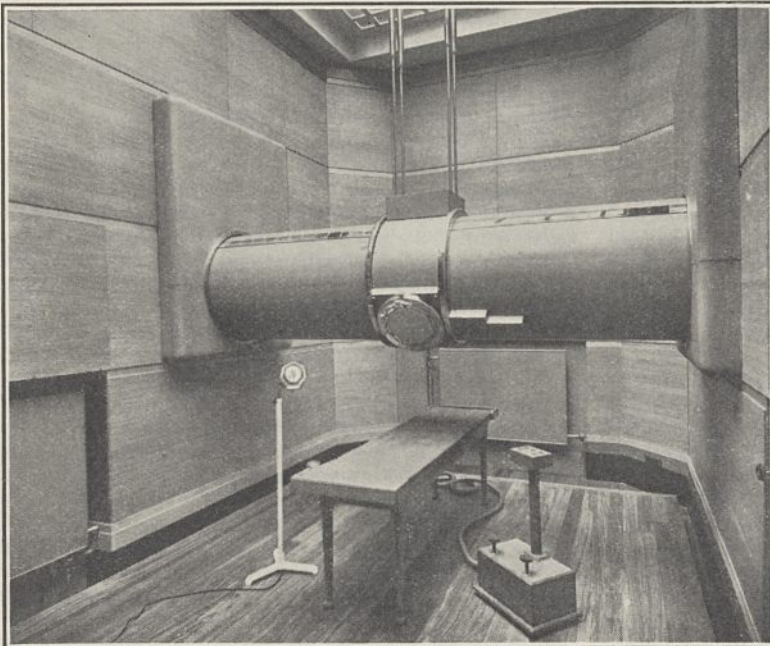


FIG. 1. Treatment room.



electric motors. In this way it is possible to direct the beam of X-rays at will, either through the applicator towards the patient, or into an absorbing lead saddle, six inches thick, suspended immediately above the tube. Thus, the portion of the X-ray tube within the treatment room is both shock-proof and ray-proof.

As the X-ray tube is fixed, the floor of the treatment room has been made movable, so that the position of the patient relative to the tube may be adjusted as desired.

### THE GENERATORS

The generating equipment comprises two generators, one designed to give a positive potential of 600,000 volts, and the other a negative potential of the same value (Fig. 2). The current for each generator is fed from the 400 volt A.C. mains into a transformer from which a current at 150,000 volts can be drawn. By means of a modified Greinacher

circuit, embodying columns of continuously-evacuated thermionic valves and oil-immersed condensers, a rectified current at a constant potential of 600,000 volts may be obtained from each generator. Thus by using both generators, a constant potential of more than one million volts may be applied to the X-ray tube. At this voltage, the tube is designed to carry a current of five milliamperes.

The X-ray tube and its generating equipment is the culmination of the remarkable series of X-ray installations designed and manufactured during the past few years by the Metropolitan Vickers Electrical Co., Ltd., of Trafford Park, Manchester. The company is to be congratulated on its fine achievement.

The Treasurer and Governors of St. Bartholomew's Hospital, also, should be congratulated on the vision and energy they have displayed in their endeavour to further the conquest of a dread disease. We wish the new department all success in its work.

## Illumination Research at the Science Museum

THE special Exhibition on Electric Illumination being held at the Science Museum (see NATURE of December 19, p. 1046) contains a number of research exhibits of considerable interest.

One item from which valuable results may be obtained has been contributed by the National Physical Laboratory and has been designed under the supervision of Dr. J. W. T. Walsh. Two light sources, one a tungsten filament lamp and the other equivalent to the mercury discharge lamp, may be adjusted by the observer until equal brightness appears to be obtained by means of a photometer head. When this has been done, the observer records his observation automatically on a roll of paper, thereby contributing towards the accumulation of mass statistics on popular conceptions of heterochromatic photometry. Practically all observations on this subject have been done hitherto by trained observers. It will be interesting to check whether the untrained observer, some 250,000 of whom will probably visit the exhibition, has substantially the same outlook on the question of equal brightness of differently coloured light sources. A rough check with a small number of completely untrained observers at the National Physical Laboratory revealed considerable disparities compared even with the observations of the less-experienced trained observers. The value of a check test to reveal the disparity range in the visual experiences of the general public may be considerable.

Another experimental device with the object of obtaining mass statistics has been installed by the E.L.M.A. Lighting Service Bureau. Variations in the foot-candle intensity chosen by members of the public for comfort in reading are recorded by a ticket issuing machine which, in addition to delivering a ticket showing the value chosen by the operator, records statistically the sum of its operations. Although 5 foot-candles is an average value of illumination experienced in living rooms, it has been found as a result of 20,000 observations that 70 foot-candles is much nearer the desired value for comfort. Further statistics will be obtained at the Exhibition.

A number of other items in the Exhibition illustrate contemporary research without contributing towards it. One most interesting exhibit projects the arc from a mercury discharge lamp on to a translucent screen, and by means of a stroboscopic disk shows that while the cathode discharge emanates from a hot spot on the cathode, the anode discharge takes place from the surface of the electrode presenting the shortest discharge path to the arc. If both these discharges were to take place from the same spot, disintegration of the electrodes would ensue and the lamp life would be uneconomically curtailed. This device, which has been used extensively by research workers to obtain a proper understanding of the processes involved in sustaining the arc discharge in a hot cathode discharge lamp, is now demonstrated to the public.

The phenomenon of luminescence, discovered by Crookes in 1879 and now applied to electric discharge lamps, is demonstrated by a number of cabinets in which only invisible ultra-violet radiation is allowed to fall on luminescent specimens. The first cabinet shows naturally luminescent minerals. The second shows stages in the preparation of a synthetic luminescent material. Pure zinc sulphide is not luminescent, and does not become so with the addition of an impurity. When, however, the mixture is fired, the resultant product is strongly luminescent. Two further cabinets show the response of some materials to long-wave ultra-violet radiation and others to short-wave ultra-violet, and the fact that a material responding to the one may be unresponsive to the other. A fifth cabinet shows the response of the rhodamines which, strangely enough, respond only in the pure form and then only when in either solid or liquid solution.

The water-cooled high-pressure hot cathode mercury discharge lamp is an example of what is at present a research exhibit, but may before long have important practical applications. The tube is of quartz surrounded by a condenser, and from examination of the spectrum of the discharge it is estimated that a temperature of about 8,000°C.—approximately that



of the sun—is reached. The light source is 0.5 mm. diam. × 50 mm. long, the pressure 100–200 atmospheres and the power consumption 1,000 watts. An efficiency of 60–70 lumens per watt is obtained. While the life of these lamps is at present only about 100 hours, the red end of the spectrum of the discharge is about ten times as strong as that of an ordinary street-lighting mercury lamp. The colour rendering of the light obtained is thus far more akin to that

obtainable by daylight. Even the commercial high-pressure quartz lamp, which will probably be marketed in a few months' time and which works at a pressure of about five atmospheres and a temperature of about 1,000° C., shows a substantial improvement in the red end of the spectrum. Spectrometer demonstrations of the light from these lamps compared with that from tungsten filament lamps are shown.

## Universities of the British Empire

### FIFTH QUINQUENNIAL CONGRESS

AT the fourth Congress of the Universities of the British Empire in 1931, Sir Donald MacAlister observed that not merely for historical or statistical records, but also for the clear and cogent setting forth of current university problems, and for pertinent and practical suggestions for their solution, it had long been his practice to consult the reports of the Proceedings of these Congresses, and seldom in vain.

The Proceedings of the Fifth Congress, held on July 13–17, 1936 in Cambridge\*, in no way fall below the standards established by its predecessors, and suggest that the analysing and Socratic methods of the world's earliest university are alive in the modern world's counterparts of the Academy of Athens. "They say. What say they? Let them say," is the background of their work and effort—taking toll of the past, working for the present, planning for the future—a readiness to discard the unprofitable, to adapt means to ends and to envisage change.

The Prime Minister in his opening address took his stand on the plane of a lofty idealism which stressed the presence of the spirit of youth, of growth, of vigour, of expansion and of adventure in his own university and the hatred of standardization and mass production—common to all universities; and pleaded for the production of poets like Wordsworth who might inspire Europe and the world with a sense of unity and freedom.

On other aspects of the problems confronting universities, Mr. Baldwin was no less insistent. Research workers should be freed from the trammels of too much teaching and relieved from financial anxiety. Communal life is by no means the least important part of the training obtained at universities—a view strongly expressed in the latest report of the University Grants Committee. Universities may have to specialize in certain subjects and arrange for an exchange of students in the event of their being unable to provide for complete instruction in any subject—the latter suggestion recently happily adopted by the Universities of Oxford and Cambridge.

It was appropriate that the Chancellor should be followed by the Vice-Chancellor, who discoursed on some problems which confront universities. He, too, referred to undue specialization and its dangers—making mention of the arrangement come to with the University of Oxford in respect of the School of Forestry. He had also much that was pertinent to

say about training for citizenship—a subject to the discussion of which Sir Ernest Simon made a valuable contribution in his remarks on general, as an alternative to specialized, honours courses, matriculation standards (a question of vital concern to all educational institutions, schools as well as universities), pass degrees, intensive courses in honours subjects, research, libraries, need for wider exchange and health measures for students.

Following this address, the subject of the provision in Great Britain for post-graduate studies for British and overseas students was introduced by Lord Macmillan, who made an eloquent appeal for the establishment of an institute of legal research. The Vice-Chancellor of the University of London gave a lucid description of what is being done for post-graduate medical education by the British Post-graduate Medical School. Lord Rutherford explained what his department is doing at the Cavendish Laboratory, Cambridge; and one of his colleagues, Prof. J. A. Ryle, told of the development of research in pure medicine at Cambridge. Lord Nuffield's recent munificent gift to Oxford will enable research to be conducted in other departments of the medical faculty.

The functions of universities in the training of teachers was introduced by Sir T. Percy Nunn. One of the more important and trenchant of his observations was that the universities through their technical departments of education should do more to foster education as a national function. Others spoke on the subject from the point of view of overseas institutions, while the Board of Education, through its chief inspector, suggested certain criticisms of university methods to which full consideration should be given. Among these is the isolation of the teacher's life which, as Prof. Frank Smith of Leeds said, must not constitute what is really a condition of imprisonment.

Dr. H. J. Cody, president of the University of Toronto, delivered an address on the relation of Canadian universities to national life, making particular mention of academic freedom, the importance of the great and inspiring teacher and of physical training.

Two subjects for discussion—careers for university students and physical education in the universities—were, as was appropriate, concerned with the well-being of those for whom university education is provided. Great Britain is happy in that it has not experienced as yet the effects of a surplus of failed aspirants for university degrees or even of 'failed matrics'. A career for the university graduate is not

\* Fifth Quinquennial Congress of the Universities of the British Empire, 1936. Report of Proceedings. (Published by the Universities Bureau of the British Empire.) Pp. viii+262. (London: G. Bell and Sons, Ltd., 1936.) 21s.



the problem it is in India or in many countries of Europe. More than one warning, however, was uttered that the universities are nearing saturation point, and that a pass degree or one of the hundreds of diplomas conferred by universities may not in the future be the qualification for an appointment which it is to-day. It was even suggested that already some employers place small value on the Ph.D. degree.

That the universities are awake to the problem of ensuring that a university degree is not a dead end is patent from the efforts made by appointments boards such as that at Cambridge to discover men for the work for which they are best adapted. The discussion suggested, however, that many appointments boards are left with the surplus, and do not supply the best men, particularly for posts abroad, for which, though eminently suited, they are deterred from making application by hopes of promotion in the mother country, by home ties, by ease of living and by the decay of the spirit of adventure. The speech of one of the Indian delegates may be read as an indictment of the spinelessness of the youth of Great Britain. Physical training is excellent as a means of creating the *mens sana in corpore sano*, but if it produces little more than brawn and muscle attached to a partially functioning purpose, it is but a play *in vacuo*.

The need for wider interchange of the best products of university training was again and again emphasized. Famous interchanges do occur. The vice-chancellors of Cambridge, of Bristol, of Aberdeen and of Melbourne are instances. That they are not more frequent is not the fault of Great Britain alone. It is understandable that a local candidate for an appointment has a better chance than one who has to rely on academic qualifications, teaching experience and successful research—reported at second hand and based on testimonials supplied by the candidate himself. Unless, however, a sense of responsibility for 'circulating' the abilities available becomes more sincere than it is at present, the outlook is poor. The hope was expressed that an inquiry into the possibility of providing better facilities for interchange might be fruitful.

With those who, while not specialists in the narrow sense pleasing to the pure academician, are capable of undertaking research in industry, in commerce, in agriculture and in Government services under direction and with particular ends in view, possibly the future may lie. This possibility has some relevance to the question of the value of general as an alternative to specialized honours courses, because in spite of the disdain of those who think only in terms of pure scholarship, the graduate who has not pursued his studies in one subject only may find a natural aptitude for research in a subject other than the main subject in which he has taken his degree. In any case, he may be less rigid and more adaptable. This view has recently been reinforced by the president of Princeton University who, in his annual report, uttered the warning that many of the world's vexing problems fall in the interstices between the organized departments of scholarship. It is incumbent upon science and learning to develop an attack upon the 'no man's land' of knowledge and if such an attack is to be successful, universities must strive to surmount departmental boundaries and consciously encourage young men to think comprehensively, and, as a step to this end, to develop new tools of thought with which to reason more broadly.

The volume under review also contains an address by the president of the Board of Education on the relation of secondary schools to the universities, in which he stressed the historical connexions between schools and universities.

The discussion on university examination methods revealed a very wide diversity of opinion, particularly in respect of internal and external examiners. In view of recent criticisms of examination methods, it was perhaps well that it should be proclaimed that no examination of standing was ever conducted in the manner devised by the group which "examined examinations".

Other contents are a paper by Sir Geoffrey Evans on tropical agriculture as a career and a note by Prof. J. Stanley Gardiner on Wicken Fen.

One subject which was not discussed—probably because so far it has not become an acute problem in the British Empire—is the revolt of youth in other countries against university standards of integrity and dispassionate inquiry. Lord Eustace Percy, in a recent address to the London School of Economics, went so far as to suggest that the universities of the world are as a whole losing their position of authority and leadership, and uttered the warning to universities in Great Britain that the danger to fear is a growing impatience with their traditions and practice—a mood of indifference not unmixed with contempt. In a similar vein of thought the Vice-Chancellor of the University of Oxford in his annual review observed: "The belief in dispassionate inquiry and impartial knowledge has many enemies in the world to-day, and perhaps the most alarming fact about the perversion of University standards which we have seen happening elsewhere is that the change seems on the whole to have been welcomed rather than resisted by the younger generation. It looks as though it was going to be harder to hand on to coming generations than it has been in the past the true faith of a University." Perhaps, as the latter further observed, hope for the future is to be found in that in Oxford and Cambridge with their collegiate system and in other universities with the establishment of halls of residence, the members of universities are living or are coming to live together in communities in which all elements and classes in the country are represented, where, whatever their different views as to the needs of the country and the ways of meeting them, they can share in common standards of learning and scholarship.

The free discussion of problems connected with university affairs such as was the marked feature of the Cambridge Congress may also serve as a corrective of present-day discontents.

Throughout the Congress, which was one of the most successful held, continual references were made to the Universities Bureau of the British Empire—the work it is performing and the possibility of the extension of that work. The Quinquennial Report of the Executive Council reproduced in the Proceedings is a clear indication of the need for the Bureau. Its "Universities Yearbook", its recently published Handbook of Information for Overseas Students on the facilities available at university institutions of Great Britain and Ireland, the number of appointments for overseas institutions which it makes, the scholarships it distributes—among which the most valuable have been those made possible by a grant from the Carnegie Corporation of New York—are in themselves sufficient indication that the Universities Bureau is meeting a want in the university system of the Empire.



## Educational Topics and Events

CAMBRIDGE.—The Adam Smith prize, of the value of £40, offered annually for an essay on some unsettled question in economic science, has been awarded to D. G. Champernowne (King's College).

G. W. Robinson (Gonville and Caius College), professor of agricultural chemistry, University College of North Wales, Bangor, and H. W. Harvey (Downing College) have been approved for the degree of Sc.D.

EDINBURGH.—The following appointments have recently been made: Dr. J. A. Kitching, lecturer in zoology at Birkbeck College, London, to be lecturer in experimental zoology; O. A. Trowell, fellow of St. John's College, Cambridge, to be lecturer in physiology; Alexander Brown, to be full-time assistant in physiology; Dr. Frederick Bath, lecturer in mathematics in University College, Dundee, to be lecturer in mathematics.

LONDON.—Dr. Edmund Giffen has been appointed University reader in mechanical engineering at King's College. Since 1931 he has been lecturer in the Engineering Department at the College.

The following have received the title of reader in the University: Dr. R. E. Gibbs (physics), in respect of the post held by him at University College; Dr. S. V. Keeling (philosophy), in respect of the post held by him at University College; Dr. D. M. Newitt (chemical technology), in respect of the post held by him at the Imperial College—Royal College of Science.

The title of emeritus professor in the University in the subjects indicated has been conferred on the following: Sir Grafton Elliot Smith, on his retirement from the University professorship of anatomy at University College; Prof. M. T. M. Ormsby, on his retirement from the Chadwick professorship of municipal engineering at University College; Prof. A. E. Jolliffe, on his retirement from the University professorship of mathematics at King's College; Prof. W. A. Bone, on his retirement from the University professorship of chemical technology at the Imperial College of Science and Technology; Prof. Alfred Fowler, on his retirement from the University professorship of astrophysics at the Imperial College of Science and Technology; Prof. E. W. MacBride, on his retirement from the University professorship of zoology at the Imperial College of Science and Technology; Prof. S. J. Truscott, on his retirement from the University professorship of mining at the Imperial College of Science and Technology; Prof. W. W. Watts, on his retirement from the University professorship of geology at the Imperial College of Science and Technology.

The following doctorates have been conferred: D.Sc. in mathematics on W. M. Shepherd (University College); D.Sc. in zoology on Maurice Burton (King's College).

OXFORD.—The names of the members of the four boards of electors to the new Nuffield professorships in medicine were announced on December 18. The Vice-Chancellor, Sir Farquhar Buzzard and Lord Nuffield's nominee, Dr. J. J. Conybeare, are members of all four boards. The professorships have been allotted to colleges as follows: clinical medicine to Magdalen, surgery to Balliol, obstetrics and gynaecology to Oriel and anaesthetics to Pembroke. It is intended to fill two of the new chairs—surgery and anaesthetics—on January 19, 1937.

THE annual meeting of the Mathematical Association will be held at the Institute of Education, Southampton Row, London, W.C.1, on January 4-5. The retiring president, Prof. A. R. Forsyth, will deliver an address entitled "Applied Mathematics in School Training: Some General Considerations". The president-elect is Prof. L. N. G. Filon. Further information can be obtained from the Honorary Secretary, Mr. G. L. Parsons, Peckwater, Eastcote Road, Pinner, Middlesex.

## Science News a Century Ago

### William Lassell on Casting Specula

ON December 24, 1836, William Lassell (1799-1880) sent to the editor of the *Mechanics' Magazine* the last of three communications on "Casting and Grinding Specula". Lassell began life in a merchant's office in 1814, and then became a brewer in Liverpool, erecting an observatory at his home, Starfield. The process he had employed in making specula, he said, had been brought to such a degree of perfection in casting as left little to be desired in that branch of the art. His efforts had been in the direction of improvements in figuring and polishing reflectors so that these might rival the best refractors. The composition of the metal he used was 32 parts copper, 15-16 tin, and  $1\frac{1}{2}$  parts arsenic, by weight. The alloy was hard, brittle, white and susceptible of a high polish. For the copper, old copper bolts from ships had proved suitable. The specula he had made retained their polish for a long time even under unfavourable atmospheric conditions. "It was," he said, "much to be regretted that the composition of the metals of the late Sir William Herschel, exquisite as they must have been, were very prone to tarnish, so much so as to render them sometimes, even at an early age, unfit for use."

### Lyell and Darwin

ON December 26, 1836, Lyell, then president of the Geological Society, wrote to Darwin asking him to dine with him, so that they could have an opportunity of talking over a paper the latter had written. In the course of his letter, Lyell said: "I have spent the last week entirely in comparing recent shells with fossil Eocene species, identified by Deshayes. . . . Don't accept any official scientific place, if you can avoid it, and tell no one that I gave you this advice, as they would all cry out against me as the preacher of anti-patriotic principles. I fought against the calamity of being President as long as I could. All has gone smoothly, and it has not cost me more time than I anticipated; but my question is, whether the time annihilated by learned bodies ('par les affaires administratives') is balanced by any good they do. Fancy exchanging Herschel at the Cape, for Herschel as President of the Royal Society, which he so narrowly escaped being, and I voting for him too! I hope to be forgiven for that. At least, work as I did, exclusively for yourself and for science for many years, and do not prematurely incur the honour or penalty of official dignities. There are people who may be profitably employed in such duties, because they would not work if not so engaged".



## Exploration of the Mississippi

The *Times* of December 30, 1836, quoting the *St. Louis Enquirer* of November 14, said: "The distinguished French astronomer and mathematician, Mr. J. N. Nicollet, now engaged in a tour of scientific observation through the different states and territories of the Union, has recently visited the northern regions of the United States, and succeeded in penetrating further into the interior, with a view of making the discovery of the true source of the great 'Father of Waters' than has even been before accomplished. Mr. Nicollet left Port Snelling, mouth of the St. Peter's, about three months since, and at great expense and trouble transported his splendid set of astronomical and other instruments through a country offering obstacles at every step, taking advantage of every opportunity to ascertain latitudes, longitudes, the magnetical variation and dip, the intensity of the force of gravity, geological and mineralogical examination, and indeed every other observation connected with the science, which might be considered useful, not only to himself and the various scientific and literary societies in Europe and the United States, to which he belongs, but to the whole scientific world. . . ."

"It is laid down and established by Mr. Nicollet that the true source of the 'Father of Waters' is to be found in five different rivers, an extension of the waters of which forms La Beasch Lake. Thus has the honour of this discovery so long contended for by many travellers and writers, been reserved for Mr. Nicollet, and we sincerely hope he may succeed (as no doubt he will) in the establishment of his superior claims to the distinction."

## Dutrochet's Experiments in Vegetable Physiology

In the *Athenæum* of December 31, 1836, under the heading "The Breathing of Vegetables" was a reference to the latest researches of the French physiologist and naturalist Rene-Joachim-Henri-Dutrochet (1776-1847). M. Dutrochet, said the *Athenæum*, has recently laid before the Paris Academy of Sciences some further information on his experiments on vegetable physiology. Having observed that the pneumatic organs in different parts of *Nymphaea lutea* contained an air in which there was less oxygen in proportion as these parts were distant from the leaves, it struck him, that the leaves were the sources whence these organs derived their oxygen, and that this oxygen was disposed of by the breathing of the plant, as in animals. After stating his observations at length, M. Dutrochet said: "The results of these experiments are, that the oxygen produced by the leaves under the influence of light is first poured into the pneumatic cavities: into these it is pressed by continued accumulation, and escapes to the outer surface by means of the tracheæ, the orifices of which are situated in the air, and on the leaves. Most of the aquatic plants have these orifices so contrived as not to be entirely closed when in contact with the water, but a few are without these mouths, and then the oxygen is crowded into the pneumatic canals of the footstalks, and from thence is pressed into the stem, which accounts for the enormous quantity of water contained in some of the aquatic plants". Dutrochet re-published the most important of his researches in his "Memoires pour Servir à l'histoire anatomique et physiologique des végétaux et des animaux" in 1837.

## Societies and Academies

## Dublin

Royal Dublin Society, November 24, 1936.

H. H. DIXON: The convection of heat and materials in the stem of a tree. When heat is applied locally to the stem of a tree, it is conducted and conveyed both upwards and downwards. The convection is brought about by the movement of material. By means of suitably devised and controlled arrangements, the velocities and the times of these movements may be ascertained and recorded. Movements quite distinct from the movement of water upwards from the roots to the leaves have in this way been observed. They take place in winter, spring and autumn, as well as in summer. They may be found when the tree is bare of leaves and in the darkness of night. While the water from the soil moves upward in the wood, the bark is indicated as the channel for these movements.

J. H. J. POOLE: A new method of measuring the radioactivity of rocks. The powdered rock is heated in a carbon boat carrying a current of about 400-500 amperes in a water-cooled vacuum furnace. The gases evolved, including the radon from the radium present, are then pumped into a previously exhausted ionization chamber, where the number of alpha particles due to the radon and active deposit is counted by means of an amplifier of the Wynn Williams type and an oscillograph. The results so far obtained agree reasonably well with previous measurements made by other methods. An account was also given of some measurements of the radium content of specimens of basalt from the bottom of the Indian Ocean, made by the usual furnace method. The results are appreciably lower than those for surface specimens of basalt.

G. T. PYNE and J. J. RYAN: Investigations on a molecular constant for soured milks. An application to soured milk of the method previously described for the determination of the cryoscopic constant of fresh milk from measurements of its refractive index, chloride content, and soluble phosphate content.

## Paris

Academy of Sciences, November 30 (*C.R.*, 203, 1105-1192).

EMILE BOREL: The problem of chances.

HENRI DOUVILLÉ: The shell of the *Ostreoides*, of the group of *Ostrea cochlear*, genus *Pycnodonta*, and the shell of the Rudists.

RAZIIDDIN SIDDIQI: The theory of non-linear partial differential equations.

J. FAVARD: The approximation of periodic functions by trigonometrical polynomials.

V. A. KOSTITZIN: The asymptotic solutions of biological differential equations.

EDMOND BRUN: Study of the friction of a solid moving in water. When an ebonite disk is rotated at a high velocity in water, there is a measurable temperature difference between the solid and the water; this difference is a function of the distance from the axis of rotation, and is proportional to the square of the velocity of rotation.

JEAN CHAZY: Certain laws of gravitation corrective of Newton's law.



**HENRI CAMICHEL**: The spectrum of Nova Lacertæ observed with the large telescope at Meudon. The results are in general agreement with what is known about novæ, but there are certain peculiarities. Nova Lacertæ differs from Nova Herculis: its light curve is of the rapid evolution type, its emission lines are wide and badly defined, and it shows lines of interstellar sodium.

**BERNARD KWAL**: The spatio-temporal fixing of positions and relations of uncertainty in quaternionic quantum mechanics.

**PHILIPPE TONGAS**: A new empirical expression for the specific volume of super-heated steam.

**DAVID RAISKY**: A new musical string instrument, the bass violin. The instrument described has the range of a violoncello with dimensions approximating to those of a violin.

**GEORGES FOURNIER**: A geometrical theory of matter.

**DOUCHAN AVSEC and MICHEL LUNTZ**: Electroconvective vortices. In an electrostatic field, formed in oil between two plane parallel electrodes, cellular vortices of the Bénard type are formed. It is suggested that the existence of these electroconvective vortices may explain a large number of physical, meteorological, astrophysical and crystallographic phenomena.

**AUGUSTIN BOUTARIC, LOUIS FERRÉ and MME. MADELEINE ROY**: Spectro-photometric researches on the colour of wine.

**TIEN KIU**: Photographic plates sensitized with sodium salicylate. Treatment with sodium salicylate solutions increases both the contrast and sensibility in the visible spectrum. The action of this reagent is more complex than was at first supposed: the fluorescence theory is insufficient to cover the whole of the facts.

**EMILE SEVIN**: Zeeman's phenomenon.

**ROBERT J. WALEN and MAURICE E. NAHMAS**: Research on the negative proton and some artificial radioactivities.

**MARCEL PRETTRE**: The laws governing the initial acceleration of slow combustion and delay in inflammation of mixtures of pentane, oxygen and nitrogen.

**GABRIEL VALENSI**: The mechanism of diffusion through protective oxides and the influence of pressure on the velocity of oxidation of nickel.

**GEORGES CARPÉNI**: The dissociation constants of reductinic acid and its product of oxidation by iodine. As might have been predicted from its constitution and chemical properties, reductinic acid is, from the point of view of electrometric titration, in every way analogous with reductone and with ascorbic acid. This also applies to its oxidation product with iodine.

**MAX BOBTELSKY and MME. LJUBA BOBTELSKY-CHAJKIN**: The influence of added catalysts on the catalytic decomposition of hydrogen peroxide in the presence of bichromate.

**HUBERT FORESTIER and FRANCIS REDSLOB**: Decomposition of cadmium ferrite. Study of the conditions under which cadmium ferrite acquires ferromagnetic properties: these properties are shown to be due to the ferric oxide in an unstable ferromagnetic form.

**HENRI GUÉRIN**: Combined action of hydrogen and heat on the arsenates of the alkaline earths.

**SÉBASTIEN SABETAY**: A method for the rapid diagnosis and approximate estimation of the primary alcohols, in the presence of secondary and tertiary

alcohols, by the formation of tritylic esters. The reagent proposed is triphenylchloromethane, which gives esters with primary alcohols of the type  $(C_6H_5)_3COR$ .

**A. VILA**: Application of distillation in a cathodic vacuum to the definition of pitches and bitumens.

**PIERRE CHATELAIN**: Study of parazoxyanisol in the solid, anisotropic liquid, and isotropic liquid states.

**FERNAND JACQUET**: The southern side of the Tindouf synclinal in the regions of northern Mauritania.

**LOUIS DUBERTRET**: The stratigraphy of the regions covered by the green rocks of north-west Syria.

**MAURICE HOCQUETTE and LÉON ARSIGNY**: The mode of formation, action and destiny of the prehaustorium of *Cuscuta epithymum*, var. *trifolii*.

**RAYMOND HAMET**: The botanical origin of the drugs known in Brazil under the name of 'catuaba'.

**RENÉ COUTEAUX**: The bacteroids of worms and their relations with sarcocystis.

**JEAN JACQUES BOUNHIOL**: The limits of ecebration of the larvæ of Lepidoptera compatible with nymphosis.

**PIERRE NICOLLE**: Researches on the role of the hormones in the physiological variations of the reticulocytary ratio in the rabbit.

**GABRIEL GUIGNON**: The influence of sunlight on the flight of the diurnal Lepidoptera.

**ALBERT VANDEL**: The mode of distribution of the sexes in *Trichoniscus (Spiloniscus) provisorius*. The heredity of monogeny.

**A. H. ROFFO and A. E. ROFFO, jun.**: Ionization of air by irradiated cholesterol. The irradiation of cholesterol by ultra-violet light is accompanied by ionization phenomena.

## Official Publications Received

### Great Britain and Ireland

Ministry of Agriculture and Fisheries. Agricultural Statistics, 1935, Vol. 70, Part 1: Acreage and Production of Crops and Number of Live Stock in England and Wales. Pp. 99. (London: H.M. Stationery Office.) 1s. 6d. net. [912]

Royal Technical College, Glasgow. Annual Report on the One Hundred and Fortieth Session, adopted at the Meeting of Governors held on the 27th October 1936. Pp. 92. (Glasgow: Royal Technical College.) [912]

Thirty-fourth Annual Report, 1935-1936, of the Imperial Cancer Research Fund. Pp. 44. (London: Imperial Cancer Research Fund.) [1012]

Broadcasting. Drafts of (1) Royal Charter for which the Postmaster General proposes to apply for the continuance of the British Broadcasting Corporation; and (2) Licence and Agreement between His Majesty's Postmaster General and the British Broadcasting Corporation. (Cmd. 5329.) Pp. 26. (London: H.M. Stationery Office.) 4d. net. [1112]

### Other Countries

Department of Scientific and Industrial Research: Cawthron Institute. Pasture and Soils Research Publication No. 35: The Importance of Cobalt in the Treatment of certain Stock Ailments in the South Island, New Zealand. By H. O. Askew and J. K. Dixon. Pp. 73-92. (Wellington, N.Z.: Government Printer.) [812]

New Zealand: Department of Lands and Survey. Annual Report on Scenery-Preservation for the Year ended 31st March 1936. Pp. 8. (Wellington: Government Printer.) [812]

New Zealand State Forest Service. Bulletin No. 8: *Diplodia pinea* in New Zealand. By T. T. C. Birch. Pp. 32. (Wellington: Government Printer.) 1s. 9d. [812]

Union of South Africa: Department of the Interior, Bureau of Archeology. Map of Prehistoric Paintings and Engravings. Scale of 1-014 in. to 40 Statute miles=1:2,500,000. 36½ in. x 28½ in. (Pretoria: Government Printer.) [812]

British Honduras. Report of the Forest Trust for the Year ending 31st December 1935. Pp. 28. (Belize: Government Printer.) [1012]

Western Australia. Annual Progress Report of the Geological Survey for the Year 1935. Pp. 44. (Perth: Government Printer.) [1012]



## Recent Scientific and Technical Books

Volumes marked with an asterisk (\*) have been received at "NATURE" Office

## Mathematics : Mechanics : Physics

**Andrade, E. N. da C.** The New Chemistry. Med. 8vo. Pp. 58 + 8 plates. (London: G. Bell and Sons, Ltd., 1936.) 3s. 6d. net.\*

**Andrade, E. N. da C.** The Mechanism of Nature: being a Simple Approach to Modern Views on the Structure of Matter and Radiation. Revised and enlarged edition. Ex. Cr. 8vo. Pp. xii + 188 + 8 plates. (London: G. Bell and Sons, Ltd., 1936.) 6s. net.\*

**Barbillion, Louis.** Physique de l'ingénieur. Tome 1: Généralités, mesures, les trois états physiques de la matière, chaleur. Roy. 8vo. Pp. vii + 162. (Paris: Libr. Dunod, 1937.) 38 francs.

**Blackett, P. M. S.** Cosmic Rays: being the Halley Lecture delivered on 5 June 1936. Demy 8vo. Pp. 26 + 2 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 2s. net.\*

**Burnett, Major J. C.** Easy Methods for the Construction of Magic Squares. Cr. 8vo. Pp. 77. (London: Rider and Co., 1936.) 2s. 6d. net.\*

**Congrès International de Physique**, organisé par l'Union Internationale de Physique et la Physical Society, Londres, 1934. 1: Les rayons cosmiques. Roy. 8vo. Pp. 47. 10 francs. 2: Transmutations. Roy. 8vo. Pp. 83. 18 francs. 3: L'État solide de la matière. Roy. 8vo. Pp. 72 + 3 plates. 18 francs. (Actualités scientifiques et industrielles, 340-342.) (Paris: Hermann et Cie., 1936.)\*

**Darrow, Karl K.** The Renaissance of Physics. Demy 8vo. Pp. viii + 306 + 17 plates. (New York: The Macmillan Co., 1936.) 12s. 6d. net.\*

**Davis, Harold T.** The Theory of Linear Operators: from the Standpoint of Differential Equations of Infinite Order. (Monograph of the Waterman Institute of Indiana University, Contribution No. 72.) Sup. Roy. 8vo. Pp. xiv + 628. (Bloomington, Ind.: The Principia Press, 1936.)\*

**Edwards, E. J.** An Illustrated Historical Time Chart of Elementary Mathematics: for Senior and Secondary Schools, Training Colleges and Universities. In 5 Sections, each 3 1/2 in. x 22 in. (London: University of London Press, Ltd., 1936.) On thick Cardboard, varnished, 21s. net.\*

**Feather, N.** An Introduction to Nuclear Physics. Demy 8vo. Pp. x + 214. (Cambridge: At the University Press, 1936.) 10s. 6d. net.\*

**Forrat, René.** Exposés de magnéto-optique. 3: L'Effet Zeeman dans les spectres de bandes. (Actualités scientifiques et industrielles, 363.) Roy. 8vo. Pp. 40. (Paris: Hermann et Cie., 1936.) 12 francs.\*

**Fowler, R. H.** Statistical Mechanics: the Theory of the Properties of Matter in Equilibrium. Second edition, revised and enlarged. Imp. 8vo. Pp. x + 864. (Cambridge: At the University Press, 1936.) 50s. net.\*

**Freymann, R.** Exposés de chimie-physique. 4: Les ondes Hertiennes et la structure moléculaire, 1: Méthodes d'étude du spectre Hertzien. Roy. 8vo. Pp. 39. 10 francs. 5: Les ondes Hertiennes et la structure moléculaire, 2: Absorption et dispersion dans le spectre Hertzien; applications. Roy. 8vo. Pp. 63. 15 francs. (Actualités scientifiques et industrielles, 399, 400.) (Paris: Hermann et Cie., 1936.)\*

**Froumkin, A.** Phénomènes superficiels. 1: Couche double; électrocapillarité, surtension. (Actualités scientifiques et industrielles, 373.) Roy. 8vo. Pp. 36 + 2 plates. (Paris: Hermann et Cie., 1936.) 10 francs.\*

**Hopf, Ludwig.** Materie und Strahlung (Korpuskel und Feld). (Verständliche Wissenschaft, Band 30.) Cr. 8vo. Pp. viii + 162. (Berlin: Julius Springer, 1936.) 4.80 gold marks.\*

**Interpolation and Allied Tables.** (Reprinted from the Nautical Almanac for 1937.) Sup. Roy. 8vo. Pp. ii + 44. (London: H.M. Stationery Office, 1936.) 1s. net.\*

**Krebs, W.** Clinical Colorimetry with the Pulfrich Photometer: Working Instructions for Colour Measurement on Urine and Serum and for Colorimetric Analytical Determinations in the Clinical Laboratory. Compiled and published by Carl Zeiss, Jena, in collaboration with W. Krebs. Pott 4to. Pp. 96. (London: Carl Zeiss (London), Ltd., and W. and G. Foyle, Ltd., 1936.) 7s. 6d. net.\*

**Morse, Philip H.** Vibration and Sound. (International Series in Physics.) Med. 8vo. Pp. xv + 351. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 24s.\*

**Philipp, K.** Kernspektr. (Hand- und Jahrbuch der chemischen Physik, herausgegeben von A. Eucken und K. L. Wolf, Band 9, Abschnitt 5.) Sup. Roy. 8vo. Pp. xi + 185-283 + 17-22. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 11.20 gold marks.\*

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