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Australia's Burden

IN the early years of the twentieth century, it was generally accepted—in fact it had almost come to be regarded as axiomatic—that the 'backward' races must inevitably die out. The white man's burden—to civilize the savage—was being discharged in a process of elimination. Now, however, owing in part to a stern check on the more questionable 'advantages' of civilization, in part to what may be termed compendiously the anthropological approach in methods of administration, there are populations, comparatively speaking extensive, of which the numbers are more or less decisively increasing. The peoples of the greater part of Africa are an instance in point, while even the Indians of North America, for long quoted as a tragic example of degeneration and decay, seem to have entered definitely on the upward grade. Evidence from many quarters affords no uncertain indication, not merely that degeneration and extinction are by no means inevitable concomitants of the spread of white civilization to the remoter parts of the world, but also that under regulation of cultural contact and with such a degree of provision of medical attention as civilization normally brings in its train, native communities may retain, or even actually improve, their level in the matter of population, both in respect of absolute numbers and of relative increase.

In these circumstances it is, to say the least, remarkable that pessimism should still govern the outlook on the problem of the Australian aborigines. We are told of "tribes dying on their feet" ; while a recent writer closes a review of the history and present condition of the Australian blackfellow in relation to white civilization by saying :

"As a good Australian I deplore that we must confess failure in dealing with our native races. We have studied them as museum specimens are studied, we have had humanitarian suggestions for their betterment, but we have utterly failed to keep them alive. Some outside advice is needed, or in a few years, a very few years, there will be none of these unique stone age people left—they will have gone the way of the vanished Tasmanians, the way of death." (R. H. Croll, "Wide Horizons", Sydney, 1937, p. 143.)

It cannot be denied, even when every allowance is made for the difference in theological and socio-political outlook of an earlier day, that the record of Australian civilization in relation to the aborigines is bad. It has been estimated that when white settlement first took place in Australia, the native races numbered three hundred thousand. It is quite possible that this figure is too high ; but it is generally agreed that a little over a hundred years ago they numbered at least one hundred and fifty thousand. Now, a favourable computation places them at about seventy thousand ; and it is probable that the true figure is nearer sixty thousand. One estimate is as low as forty thousand.

Impressive as are these figures, they gain in significance when viewed in relation to the desolation of the abandoned occupation sites on former aboriginal lands, and when interpreted in terms of the complete extermination of those tribes of south-eastern Australia which a little more than a generation ago afforded the anthropologist the evidence, now priceless, of the most primitive form of human society then known among living races—evidence which would be of inestimable value could it now be tested in the field in the light of modern methods of inquiry.

All this, however, belongs to the past ; and it little profits to recall it, except in so far as it is a measure of Australia's debt to the aborigines, and to stress the necessity of a change of heart towards present conditions, while pointing the way to measures of adjustment in the future. Not indeed that it is intended to suggest here that the Australian people is callous in its attitude towards the blackfellow. There is a growing recognition among individuals that the case of the aboriginal demands a 'fair deal'; and on more than one occasion a wave of public indignation has demanded that his rights should be respected and that he should be adequately protected from the effects and encroachments of white civilization.

Some years ago, not long after the Great War, the late Dr. Herbert Basedow, while on a scientific expedition to Central Australia, was aroused to indignation by conditions among the aborigines; and on his return to Adelaide, he stimulated public feeling to a degree which forced the Government to add a large tract of land to the aboriginal reserves in the centre of the continent to provide them with land adequate for the subsistence of tribes still living at the food-gathering and primitive hunting stages of social development.

Further—a fact to which too little recognition has been given in recent discussion—under all the Governments which are responsible for aboriginal administration, legislative measures have been taken for the official protection of the aborigines. The policy of the Queensland Government, as has been pointed out by the Agent-General in London (*The Times*, December 2), aims at the protection and elevation of tribalized and detribalized aborigines alike, the provision of medical attention, and—a most important function—the care of the cross-bred of superior type. Western Australia is taking measures to carry out the recommendations of the Royal Commissioner, to whose report reference was made in these columns at the time of its publication (see NATURE, **135**, 798; 1935); while the Federal Government, in addition to its existing regulations for aboriginal protection, has recently appointed, in response to public opinion, an anthropologist as Protector of Aborigines.

Nor must the efforts of the missionary organizations be overlooked. They have done, and continue to do, excellent work, which is officially recognized as part of the organization for dealing with the aboriginal. Unfortunately, in consequence of conditions over which the missions have no control, their efforts in the long run add little towards the solution of the problem.

If, then, it may be asked, both Government policy and public opinion are prepared to help the aborigines, how does it come about that all effort are of no avail? Is it really the case that the rac must inevitably die out, or is there perhaps som justification for the grave indictment of th Government and people of Australia by Prof F. Wood-Jones and others? Prof. Wood-Jone in his valedictory address to the Victorian Anthro pological Society, on leaving Australia for Man chester, it will be noted, returns to a charge whic he made some years ago before the Australasia Association for the Advancement of Science. I is to be judged from the report of his address whic has been published in England that he is of th opinion that, in the interval, nothing of any avai has been done to remedy the evils to which h formerly directed attention.

Setting aside the question whether the extinctio of the race is inevitable from inherent causes a too large for discussion here, it may perhaps b said that among the many factors operative i present conditions and affecting the future, tw stand out. Of these one is the character, mentalit and traditions of the aboriginals themselves, th other the general approach of the Australia Governments and still more of the people to th problem.

As regards the aboriginal, it has to be remem bered that the race belongs to a very primitiv stock, cut off from communication with the res of the world at a very early stage of racial distribu tion, that it lives in an arid and difficult countr where mode of life for hundreds of years, possibl thousands, has been adjusted with extreme nicet in equilibrium with environmental condition Upon this state of equilibrium an advance civilization has impinged suddenly to throw it ou of gear. Only under a prolonged period of tutelag will the aboriginal be able to adapt himself t changed conditions and new methods of gaining livelihood. That he will be able to do so ultimatel his character and abilities, as now understoo afford assurance; but it must be a form of livel hood which so far as possible should be in harmon with his tradition, aptitudes and mentality. Th he is not incapable of such training has bee shown by the work which has been done by th missions. It is the duty of the Government b patient inquiry and expert investigation to dete mine on what lines he can be trained to take h part in the future development of Australia—n as a museum piece, but as an integral part of th community. In the meantime, the provision c land for reserves and of medical attention ha been rendered frustrate by the nomadic tendencies of the tribes, their inclination to drift to centres of white civilization and their mistrust of the white man's 'medicine'. To remove these difficulties in the way of protection should be the task of a sympathetic system of administration.

Secondly, the Australian people cannot be absolved from blame. Outbursts of popular indignation at the treatment meted out to the aborigines are of little avail, even when followed by legislation, if they do not also give rise to a sense of responsibility, constantly vigilant to see that regulations are properly carried out and that abuses are promptly eliminated. When the addition was made to the aboriginal reserves in central Australia to which reference has been made above, it was laid down that no prospecting for minerals would be allowed. Yet within two years, concessions for this purpose were being sought, and it was alleged at the time that the principal agent in the matter was one who had been most active in the agitation for securing the allocation of the reserve. Other encroachments on the reserves have been tolerated. Again, it is generally accepted that it is undesirable that police officers should be asked to undertake protection duties ; yet in many instances the protectors are still policemen or officials whose other duties do not allow them to perform their function as protectors with efficiency.

It has been suggested that protection of the aborigines is a duty which should be and could best be undertaken by the Federal Government. Many hold this view. It is a matter that must be judged by the Australians themselves ; but it would seem that, provided co-operation and unity of policy can be secured as between the States, local interest might well serve as a nucleus of that strong and steady public opinion, at present lacking, which is essential to ensure that protective legislation is not only carefully framed, but also effectively put into operation.

It must seem to those who have had the advantage of examining successful systems of administration of native affairs elsewhere, that for the application of modern methods of native control, now accepted as essential for the well-being and future advancement of native races, the urgent need of Australia is a specially trained and efficient service of officers acting as protectors of the aborigines. Reference has been made in this discussion to the administration by the Australian Government of the native affairs of New Guinea and Papua. It is true that conditions there are very different from those of Australia ; but they do at least afford this lesson, that for dealing with backward peoples with success it is essential that there should be sympathy and understanding, and that these qualities can be shown best by officers who are trained in the methods of anthropology. They need not be anthropologists in the special sense, but they should be trained to a degree that will ensure that they understand the customs and mentality of the people whom they have to control, and can deal with them with understanding. The cost of such a service in Australia—heavy as it will be—should weigh as nothing by the side of Australia's reputation for fair dealing, and possibly too as against the preservation of a people who one day may find a fitting place in the promotion of Australia's prosperity.

Land for the People

The Hill Lands of Britain :
Development or Decay ? By R. G. Stapledon. Pp. 138. (London : Faber and Faber, Ltd., 1937.) 6*s*. net.

SCHOPENHAUER, in one of his discerning moods, divided authors into three classes : those who write without thinking—the most numerous ; those who think as they write ; and those who have thought before they write—they are rare. There is no doubt of the class to which the author of "The Hill Lands of Britain" belongs ; in fact, he has thought so much, done so much, and has so much to say, that out of very exuberance of spirit he sometimes forgets that language, like a living thing, has structure as well as function. His few lapses in this direction have prompted a well-known literary critic to pillory him for not being "an elegant, an easy, or a lucid writer". The indictment is far too sweeping : the author's meaning is never in doubt, his message rings clear and true.

Probably few of us realize how much of the green and pleasant land of Britain is sheer waste from the utilitarian point of view. Prof. Stapledon estimates that there are about 18 million acres of land, situated above 700 ft., covering not far short of one third of the land surface of Great Britain, which produce little or nothing for supplying the needs, material or recreative, of our people. He describes these depopulated upland areas and indicates how and why they should be mobilized for national service. On some future occasion, we hope that he will write a companion volume on the reclamation and improvement of the thousands of acres of derelict and semi-derelict land that now disfigure the lowland countryside.

Agriculturally, the productivity of our hill lands, and of much land officially designated as 'rough-grazings', could be greatly improved by fairly simple means. Briefly, the necessary operations consist in breaking up the matted surface with tractor-drawn plough or cultivator, applying lime and phosphate, and, where economically possible, sowing suitable grass seeds together with plenty of wild white clover. This is not theory ; the author and his co-workers at Aberystwyth have shown how it can be done on the uplands vested in the Cahn Hill-Improvement Scheme. To maintain and improve the fertility of farmed hill land, the fields should be kept under sown grasses for a period of two to six years ; more use should be made of cattle for grazing, and crops like oats, kale, hardy green turnips, rape and Italian rye-grass should be grown for providing winter 'keep'.

It is not suggested that all the 18 million acres are immediately improvable, but about 25 per cent is ; and the cost should not be unbearable. About £5 million a year should suffice for purchase and development of this land in the early years of a twenty-five year programme, and revenue would soon come in as rentals and taxation ; for the author has come reluctantly to the conclusion that successful exploitation of the uplands for the national good can be achieved only through State ownership. The State would also benefit from the large amount of employment the scheme would give, and from the substantial addition that would be made to our supplies of home-grown food.

It must not, however, be thought that Prof. Stapledon's plans and ideas are confined to agricultural improvement and intensification. He has a great deal to say about populating our derelict upland districts, and providing urban dwellers with facilities for visiting and staying in them about roads, tracks and transport, regional planning and education of the 'whole man'. In the last two chapters particularly, "The Non-Material Needs of the Nation" and "Dangers Inherent in Planning", he lets himself go, and gives us what almost amounts to a philosophy of right living (*savoir vivre*). For executing his plans, he does not look to the 'pure' scientist, with his nose impinging on the test-tube and his eye glued to the microscope, but rather to the scientifically educated man, like the engineer, who besides knowing how to turn knowledge into action, has rubbed shoulders with his fellow-men, and learnt to assess their faults and foibles as well as their virtues and capabilities. Nor can the author contemplate a multiplicity of administrative authorities, such as are now so common ; he would absorb them into one supreme *ad hoc* authority composed entirely of experts, like social biologists, agriculturists, foresters, engineers, surveyors, and psychologists. Although the last word would be with Parliament, all plans and administration would be carried out by experts on a wide regional basis. Excessive standardization would have to be avoided at all costs ; development and happiness of the individual would be the supreme end.

"The Hill Lands of Britain" covers essentially the same ground as that of the author's larger work, "The Land : Now and To-morrow" (see NATURE, **137**, 923 ; 1936), which it supplements and to some extent revises. There are many good things in it which have not been mentioned, but enough has been written to indicate that it represents a valuable epitome—scientific, practical, full of common sense and of uncommon vision. E. H. T.

The Cathode Ray Tube

(1) The Low Voltage Cathode Ray Tube: and its Applications. By G. Parr. Pp. x + 177 + 6 plates. (London : Chapman and Hall, Ltd., 1937.) 10*s*. 6*d*. net.

(2) Television Cyclopaedia
By Alfred T. Witts. Pp. 151. (London : Chapman and Hall, Ltd., 1937.) 7*s*. 6*d*. net.

THE use of the cathode ray tube for television reproduction was suggested by A. A. Campbell Swinton so early as 1908, and although many alternative schemes were explored in the succeeding twenty-nine years, the suggestion has borne fruit in its application to the present public television service in Great Britain. This remarkable stride in the development of radio communication has been made possible by the detailed technical improvement of the cathode ray tube, first as a laboratory tool and finally as a picture-reproducing device for use in the hands of the general public.

(1) The book by Mr. G. Parr deals with the sealed-off type of cathode ray tube operating a

accelerating potentials up to 3,000 volts. The fundamental principles of cathode ray tubes, both of the gas-focused and high vacuum types, are discussed, and the manner in which they may be operated to demonstrate their properties and performance is described. Two chapters are devoted to the various types of time base which may be utilized to delineate the wave-form pictures on the screen of the tube, and various engineering and industrial applications of the cathode ray tube are described. A concluding chapter outlines the manner in which the tube is applied to reproduce the television picture by the two principal methods which have been developed in Great Britain.

The book forms a very useful summary of the present stage of the development of the cathode ray tube, and its bibliography of some four hundred references should prove useful to those who wish to delve deeper into the subject.

(2) Since the subject of television involves a knowledge of the technical aspects of both optics and radio communication, it is perhaps not surprising to see the issue of the "Cyclopaedia" by Mr. A. T. Witts. In this work, a large number of the terms used in television technique are arranged in alphabetical order and described by text, which ranges from a simple definition to a short article occupying two or three pages. Line diagrams accompany the text where this is considered to be useful.

On account of its arrangement in dictionary form, the book does not provide a suitable means of learning the principles in the science and practice of television; but it should prove a very useful work of reference to those who already have some knowledge of the subject. Although the work is not free from some errors and omissions, these are generally of a minor character. The reviewer must confess to his ignorance of the meaning of the word "defraction", which is used several times on pp. 133–34, but is not defined.

The New Cytology

Recent Advances in Cytology
By Dr. C. D. Darlington. Second Edition. Pp. xvi + 671 + 16 plates. (London: J. and A. Churchill, Ltd., 1937.) 21*s*.

THE first edition of this book, published in 1932, contained much useful data in the form of tables, diagrams and photographs, together with theories regarding chromosome behaviour. No serious student of cytology could ignore the book, which was a mine of information, and which sometimes annoyed and always stimulated the experienced worker. The second edition is not a mere reprinting of the first, but contains a great deal of extra material which will interest cytologists. Again we find tables, diagrams and illustrations, and signs of considerable assiduity by both the author and the publisher. So great are the additions of new material that the book is larger by more than a hundred pages, in spite of the fact that the large chapter on the "Evolution of Genetic Systems" has had to be omitted.

The changes that have taken place in cytology during the past five years can be seen by comparing the contents of the first and second editions. Very full descriptions of mitosis, meiosis, structural changes, polyploids, chiasmata, crossing-over, secondary pairing, origin and behaviour of sex chromosomes, and apomixis will be found in the second edition. The theories propounded to account for the phenomena appear more stabilized and their comparative importance can be more easily grasped in the new edition. Indeed, it would appear that the main principles of chromosome behaviour in so far as they bear on genetical problems are now in a form acceptable to most cytologists. For the presentation of this alone the second edition is a valuable contribution. Other subjects, however, such as salivary gland (polytene) chromosomes, the prevalence and behaviour of inversions and "cell and chromosome mechanics", which have developed to a large extent in the last five years, are given prominence.

Considerable attention is paid in the book to the underlying causes of chromosome movement, spindle formation, and centromere action. Chromosome mechanics would still appear to be in a controversial state. It will be interesting to see if the various theories put forward in the second edition will be accepted in the future to the same extent as those of the first edition are at the present time.

As in the previous edition, there are a large and useful list of references and a glossary which contains many new terms. The majority of these are the production of the author and his co-workers. One can only imagine the number of new terms evolved by other cytologists, and the resulting difficulty in mutual understanding. An error in the definition of the *W* chromosome has crept in, while considerable humour is to be found under "Golgi Apparatus" and "Matrix". There has been more care in proof-reading, and in the preparation of the index, which, in the second edition, is a useful guide in searching for particular information in the maze of inter-related facts, remarkable theories and astonishing phraseology. Even "quart in a pint pot" has been indexed. The index has been arranged in different type so that illustrations and diagrams may be distinguished from the letterpress. Led by the index to "epigenesis", one is rewarded by: "This is the principle of co-operation which is an *a posteriori* statement of the *a priori* doctrine of epigenesis". The remarkable changes in cytology are also reflected in the relegation of parasynapsis and telosynapsis to the glossary.

This is a difficult book; but remarkable changes are still taking place in cytology. The author and publisher are to be congratulated on the production of a research monograph, profusely illustrated with diagrams and photographs, many of which are original, and containing a mass of data which will greatly stimulate workers in the field of cytology.

F. W. SANSOME.

Bird Life

(1) The Book of Birds:
the First Work presenting in Full Color all the Major Species of the United States and Canada. Edited by Dr. Gilbert Grosvenor and Dr. Alexander Wetmore. Vol. 1: Diving Birds, Ocean Birds, Swimmers, Wading Birds, Wild Fowl, Birds of Prey, Game Birds, Shore Birds, Marsh Dwellers, Birds of the Northern Seas. Pp. viii + 356. Vol. 2: Owls, Goatsuckers, Swifts, Woodpeckers, Flycatchers, Crows, Jays, Blackbirds, Orioles, Chickadees, Creepers, Thrushes, Swallows, Tanagers, Wrens, Warblers, Hummingbirds, Finches and Sparrows. Pp. 374. (Washington, D.C.: National Geographic Society, 1937.) 2 vols. 5 dollars.

(2) The Birds of the Malay Peninsula:
a General Account of the Birds inhabiting the Region from the Isthmus of Kra to Singapore with the adjacent Islands. By the late Herbert C. Robinson and Frederick N. Chasen. (Issued by authority of the Federated Malay States Government.) Vol. 3: Sporting Birds; Birds of the Shore and Estuaries. Pp. xxi + 264 + 25 plates. (London: H. F. and G. Witherby, 1936.) 35*s*. net.

(3) Check-List of Birds of the World
By James Lee Peters. Vol. 3. Pp. xiii + 311. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1937.) 15*s*. net.

(1) THE resources of the National Geographic Society have made possible the issue of a remarkably effective popular book on the birds of the United States and Canada. The text is contributed by a number of American ornithologists of high repute, whose names guarantee it as authoritative, and the extent to which the two volumes are illustrated is truly lavish. Prior publication in the Society's widely circulating magazine, over a period of years, has covered so much of the cost that the price is a low one for the value given.

Each important group of birds receives a chapter, in which an introductory account is followed by details of the separate species. Other chapters are interpolated to deal more generally with such topics as the study of migration by the ringing method or the mechanical recording of bird-song. The treatment of some questions is perhaps superficial, and the style at times rather journalistic, but the information essential to a work of this kind is well presented.

The outstanding feature is the full use that has been made both of colour drawings and of photographs—there are more than two hundred of each. The coloured plates by Major Allan Brooks are beautifully clear, and well adapted for purposes of identification: all important species are depicted, often in more than one plumage. The photographs are from various sources and reach a high standard. They have obviously been selected to give an impression of the lives of the birds rather than of their mere appearance, and in this way they admirably supplement the portraits provided by the artist.

(2) Mr. Chasen now presents the third of five instalments of a guide to the bird-life of Malaya, the death of the author of the first two volumes having been the chief cause of a gap of eight years in publication. The work is a sumptuous one, and intended primarily for local use. Its general arrangement is unusual in that the division into volumes is based on habitat instead of following a strictly systematic order. Each species, however, is dealt with on a uniform plan, a description of the bird being followed by particulars of its range, nidification and habits. The information is lucidly set forth, and the plates by Mr. Grönvold are excellent.

(3) Mr. Peters is engaged in producing a work of reference of much value to ornithologists. The information given is restricted to nomenclature and distribution, but the utility of an up-to-date standard list of all known birds is obvious. The present volume covers the pigeons and the parrots, these two orders including between them more than sixteen hundred forms.

Why Aeroplanes Fly

By Arthur Elton and Robert Fairthorne. (The March of Time Series: Mechanics, 1.) Pp. xii + 82. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 2*s*. 6*d*. net.

THIS readable book discusses the subject more broadly than the title suggests, giving a chapter upon the uses of aircraft, even going into the question of its military values. The text follows faithfully the ideal laid down in the preface of giving "the reading public a detached, simple and untechnical explanation" of the subject matter; so much so that the reviewer feels inclined to suggest that the authors under-estimate the ability of the said reading public to understand the simple ideas of natural physics and mechanics. Nevertheless, it is almost entirely free from those loose and often inaccurate statements that are usually the inevitable accompaniment of the simplification of scientific matters.

It is easy to find faults of omission in any book which has obviously been kept down in size, but there are some cases in which the authors, having embarked upon an explanation, should not have left it unfinished. For example, when discussing high wing loading as a means of increasing carrying capacity, the attendant dangers of high landing speed are mentioned, but there is nothing about the many thoroughly tried and proved methods of increasing the speed range and reducing the landing speed. One would have been inclined to have accused the authors of being out of date but for the fact that in the next paragraph they mention retractable undercarriages as a means of reducing drag, a much more modern development.

Mention of a possible "new kind of engine made like a rocket" is a case of loose terminology. This surely means that the whole aircraft would be functioning on a rocket principle.

In general, a good book for the lay reader who has been so out of touch with the modern world that he is quite ignorant of the technical aspects of flight. The illustrations are particularly good, well chosen and well produced.

The Geology of South-Western Ecuador

By Dr. George Sheppard. With a Chapter on the Tertiary Larger Foraminifera of Ecuador, by Dr. Thomas Wayland Vaughan. Pp. xiv + 275 + 13 plates. (London: Thomas Murby and Co., 1937.) 25*s*. net.

DURING the past twelve years Dr. George Sheppard has published a series of papers on various aspects of the geology of Ecuador. In this volume, which is probably the first published in English on the geology of Ecuador, he puts on record his collected data and his conclusions. The present climate and physiography are described together with the effects produced by this type of climate. The origin of the Tertiary Clay Pebble Bed of the Santa Elena region is a matter of controversy. It has been suggested that it is a crush breccia on a regional scale, but Dr. Sheppard takes the view that it was originally of the nature of a series of extensive mud streams similar to those which have been observed at the times of the heavy rains. He puts considerable emphasis on the results which may arise from these rather exceptional climatic conditions.

Some have regarded the Guayaquil Limestone as Cretaceous, but examination of the contained Foraminifera places the age as Eocene, and probably in the upper part of the series. In consequence of this and other evidence, Dr. Sheppard makes the tentative suggestion that the Guayaquil Limestone and the Seca Shales are of the same age.

Dr. Wayland Vaughan has contributed the chapter on the Tertiary Larger Foraminifera, and other chapters describe the geological structure, the igneous rocks and cherts, at some length. The final chapter deals briefly with the occurrences of petroleum.

An abundance of material is presented which provides food for thought on many points, but in giving his conclusions the author does not expect to go unchallenged on all the issues. G. D. H.

Plant Life Forms

By C. Raunkiaer. Translated by H. Gilbert-Carter. Pp. vii + 104. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 5*s*. net.

THIS type of botanical text will not be familiar to many British botanists, and therefore, although the original was written in Danish by Prof. Raunkiaer so far back as 1907, the point of view will be fresh and, indeed, invigorating.

Plants can be classified vegetatively into trees, shrubs and herbs, but this does not take the botanist very far. Most plants have to pass through a period of much-curtailed activity—winter in temperate countries and dry season in the tropics—and during this period, their growing parts, namely, the buds, must be afforded some means of protection. The degrees of protection vary according to the requirements of the different species. Prof. Raunkiaer describes the various means of protection, and these are illustrated by examples and drawings.

From this point of view, the plants are divided into the following main groups: (1) Phanerophytes, plants whose buds and apical shoots project into the air during the unfavourable season; (2) Chamæphytes, with buds and apices on shoots at or near the soil surface; (3) Hemicryptophytes, whose shoots die back just before the unfavourable period, so that surviving buds, etc., are protected by withered leaves and the soil; (4) Cryptophytes, whose surviving buds, etc., are either beneath the soil or at the bottom of water; (5) Therophytes, plants which pass their complete generation from seed to seed, that is, survive the unfavourable period as seeds. These groups are still further subdivided.

The value of plant life-forms to the study of plant geography can be well imagined, and a brief account of this is given at the end of the book.

Botanists will welcome this attractive book, and should be grateful to Mr. H. Gilbert-Carter for his excellent translation from Prof. Raunkiaer's original.

The Pleistocene History of the West Midlands*

By Prof. Leonard J. Wills

THE OLDER DRIFTS

The 'Older Drifts,' as already pointed out, are essentially either north-western (or Welsh) or north-eastern in composition. We may now examine them to determine whether they record more than one glacial epoch. For this purpose we can divide the region into two parts along a line running roughly from Derby—Lichfield—Tamworth — Coventry — Stratford-on-Avon to Moreton-in-the-Marsh.

East of this line two distinct sets of glacial deposits can be recognized on lithological and stratigraphical grounds. The older of the two, as developed in the north, is of Pennine origin, and was carried by ice travelling from the north-west; but near Coventry and Rugby, drift occupying an analogous position contains chalk and flints, and can be described as a sort of chalky boulder clay. Its apparent southerly limit is shown in Fig. 1. In the intermediate district little is known, but near Hinckley and perhaps also at Bedworth part of the older series consists of well-bedded, probably lacustrine deposits. The oldest drifts on the Blythe-Avon watershed near Stratford-on-Avon, and the 'Campden Tunnel Drift' near Moreton appear to be Welsh in origin with a slight eastern admixture. They have both been regarded as probably older than the Great Eastern glacier (Tomlinson).

Throughout all this eastern region the upper or more recent drift has been derived from the north-east and often consists of a true chalky boulder clay. It has generally and, I think, correctly been referred to the Great Eastern glaciation of Harmer.

Between the lower and the upper boulder clays in the Hinckley-Coventry-Rugby district there is a persistent bed of gravel and sand. Somewhat similar deposits, the Jurassic gravels of Miss Tomlinson, underlie the 'Main Eastern' boulder clay of the Stratford area. The 'Ditchford' or 'Paxton' gravels of the Moreton district occupy an analogous position with respect to the chalky 'Moreton Drift' (Tomlinson and Dines). In the Jurassic gravels near Stratford a single tooth of an archaic form of *Elephas antiquus* has been found, which is suggestive of interglacial conditions. Near Coventry both cold and warm climate fossils have been recorded by Shotton. In view of the close association of these deposits with two glacial series, the presence in them of tundra and temperate fossils is not so contradictory as would at first sight appear, especially as we must allow that vast lengths of time may, in a watershed area, be represented by comparatively thin deposits.

I consider that the facts in this eastern region support the idea of two distinct glaciations within the Older Drifts, with interglacial conditions between them (*First Interglacial*).

West of the Derby-Moreton line the area of the Older Drifts is sharply limited on the north by the southern edge of the later Main Irish Sea glacials (Fig. 1), which has already been discussed. Except in the Lower Avon valley, the older drifts are here Welsh.

The interpretation of these drifts is extremely difficult, partly because it is likely that if there have been two glaciations, they will be recorded by similar deposits which might occur each separately or both together on the same surface, and partly because of the great dissection and destruction that they have undergone. Many of the deposits, too, are gravels and sands that belonged rather to outwash fans than to the ice sheet itself. On the other hand, we have, as already pointed out, the river terraces to help us, by providing a record of the progressive deepening of the valleys and of the contemporaneous opening up and development of new lines of drainage on surfaces each of which appear to grade with one or other of the terraces, and which for this reason may be regarded as of approximately the same age as the terrace in question.

We may consider the Lower Avon and Lower Severn vales first. Here the highest deposit, namely the Woolridge Terrace, is developed between Tewkesbury and Gloucester, and up the Leadon valley at heights between 200 and 285 O.D. I have elsewhere suggested that the Leadon valley deposits were laid down by water travelling west of the Malvern range and forced to take this course by the filling of the Severn vale by the Welsh ice when at its maximum. At this stage, too, the ice seems to have carried Welsh boulders to the Moreton-in-the-Marsh district and to have been responsible for certain very high-level drifts in Worcestershire. For these reasons I picture it as stretching over the vales of Severn and Avon

* Continued from page 997.

to the Cotteswold escarpment. A slight retreat would have allowed outwash material to be laid down below Tewkesbury. Patches of this have survived at Woolridge (260 O.D.), Norton Hill (283 O.D.), and Corse Hill (250 O.D.). These and some other very high deposits seem to belong to this early stage and to be the most likely equivalents of the lower boulder clays of the Upper Avon valley and of the Pennine drifts of the Trent, Soar, and Wreak valleys.

If we accept this view, it follows that the retreat of this *First Welsh Glacier* was connected with the 'first interglacial' episode for which we have discussed the evidence in the Upper Avon valley. In the Lower Severn vale the Bushley Green Terrace, containing a temperate shell fauna and lying at a considerably lower level than the Woolridge Terrace, appears to belong to this time. The Bushley Green correlates with the Avon No. 5 Terrace of Miss Tomlinson, but for several reasons I picture the latter as somewhat later in date though graded to about the same level. On this view the Bushley Green and Avon No. 5 Terraces cover the 'first interglacial' episode and the oncoming and maximum stage of the Great Eastern glacier in the Avon Vale.

What then of the rest of the region ? There are certain data and several lines of reasoning* which in my opinion justify us in postulating the existence during the Great Eastern Glaciation of a Welsh ice sheet reaching across the Stour and Salwarpe valleys, and covering the Black Country, East Worcestershire and the Warwickshire Plateau (Fig. 2). There is, however, no clear-cut evidence to prove whether it was the shrunken First Welsh, or, as I think more likely, a *Second Welsh* ice-sheet which, as the first interglacial epoch passed away, grew and invaded the northern part of the same region, incorporating to some extent in its deposits the drifts of the earlier advance.

The retreat of this glacier is illustrated diagrammatically in Fig. 2.

The first position shown is indicated by a line with double offsets. This line conforms with Miss Tomlinson's maximum 're-advance' in the Blythe valley ; with the considerable development on the Ridgeway of drifts with both north-eastern and north-western erratics which may have owed their origin to the combined efforts of the two glaciers ; and with the gravels and sands of the Stoulton-Besford area which I have just referred to as grading to the same level as Avon No. 5 Terrace. As the two sheets withdrew, the drainage down the Avon was responsible for the formation of some parts of the same terrace. It appears necessary to imagine the Severn valley from Worcester downwards as having already been established, possibly as a marginal flow along the edge of the First Welsh Glacier.

* These are outlined in the printed address.

The second stage deserves more elaboration ; but this cannot yet be achieved, owing to want of data. The line indicated with three offsets must therefore be regarded as a composite representation of several that it would be necessary to draw in order to satisfy even the evidence we now possess. East of Birmingham the line represents a lobe in the Tame basin connecting near Tamworth with the Eastern ice of the Anker and Trent valleys. This disposition of the two sheets would enable us to account for the Blythe valley lake suggested

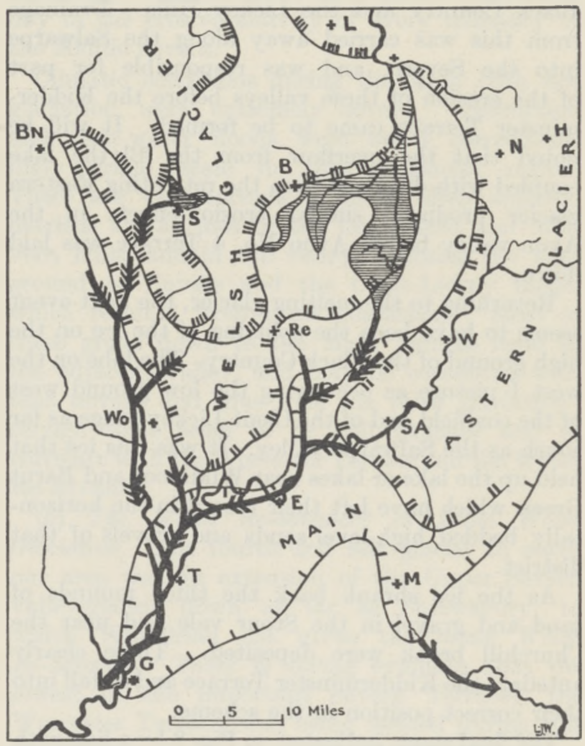

Fig. 2.

POSSIBLE SUCCESSIVE STAGES OF RETREAT OF THE SECOND WELSH AND OF THE GREAT EASTERN GLACIERS. HORIZONTAL RULING INDICATES GLACIAL LAKES ; ONE-BARBED ARROW, BUSHLEY GREEN TERRACE OF SEVERN, AND WOLVERCOTE TERRACE OF EVENLODE ; TWO-BARBED ARROWS, AVON NO. 5 TERRACE ; THREE- AND FOUR-BARBED ARROWS APPROXIMATE TO THE KIDDERMINSTER TERRACE.

in the Birmingham Memoir and described by Miss Tomlinson. It drained southwards by the Kingswood Gap to the Alne valley during the Stratford stage of the Great Eastern Glacier (Tomlinson).

Ice approximately in the position shown for this stage could also account for the Cole valley lake, the Moseley gravels, and the barrier of sands which turn the Cole eastwards near Castle Bromwich. Fig. 2 also indicates a lake in the upper Rea valley, south-west of Birmingham. This expresses the hypothesis that certain clays, such as the 'india-rubber clay' of California and the similar deposits at Parson's Hill, King's Norton, may have originated as lake clays when the Rea valley was obstructed by ice that impounded water up to about 550 O.D.

The line further coincides to the south-west of Birmingham with the gravel deposits of Rowney Green near Alvechurch, which may be regarded as marginal in origin. The lobe stretching southwards complies with the necessity for an extension into the lowlands of an ice-sheet that was mighty enough to overspread the high ground of the Black Country and the Lickey Hills. Drainage from this was carried away along the Salwarpe into the Severn, and was responsible for part of the erosion of these valleys before the Kidderminster Terrace came to be formed. It will be noted that the overflow from the Blythe lake coupled with drainage from the retreating Eastern glacier produced similar erosion-effects in the Avon valley before Avon No. 4 Terrace was laid down.

Returning to the melting glacier, the next event seems to have been the splitting of the ice on the high ground of the Black Country. The lobe on the west I picture as occupying the low ground west of the coalfield and of the Clent-Lickey range as far south as the Salwarpe valley. It was this ice that held up the lake or lakes near Wildmoor and Barnt Green which have left their record in the horizontally bedded high-level sands and gravels of that district.

As the ice shrank back the thick mounds of sand and gravel in the Stour vale and near the Churchill brook were deposited. These clearly antedate the Kidderminster Terrace and so fall into their correct position in the scheme.

The final stage, indicated on Fig. 2 by a line with five offsets, was suggested to me by Mr. T. H. Whitehead. There is much evidence to justify the assumption that in pre-Glacial times the Stour flowed northwards as far as Hinksford, where it rounded the end of the then unbroken Bunter Pebble Bed escarpment. Ice in the position shown on the map would, as already suggested, have impounded a lake in the upper Stour valley, the overflow from which might have initiated the present gorge of the Stour through the Bells Mill Gap. The sands of the so-called Kingswinford Esker can be regarded as having originated in this lake.

All the records of the further retreat of the Welsh ice sheet have been obliterated by the invasion of the later Main Irish Sea glacier.

The evidence relating to the Older Drifts that we have been considering is scattered, difficult to interpret and usually ambiguous; but nevertheless I feel some confidence in the correctness of the main features of its interpretation, namely, that there were two glaciations involved. In the first the ice movement was from North Wales and the Pennines towards the south-east: in the second there was a similar, but less powerful North-Welsh dispersion with some slight intermingling of Irish Sea material. Simultaneous with this, however, in the east and in the Avon valley was the Great Eastern glacier.

By the end of the First Glacial epoch the general trend of the lowest parts of the Severn seem to have been established as marginal channels bordering the ice which lay thickest in the Salwarpe-Piddle Brook depression. The first and the second glaciations were probably separated by truly interglacial conditions (First Interglacial).

The Second Glaciation came to an end in the *Second* or *Great Interglacial* epoch which intervened between the deposition of the Older and Newer Drifts. In the area under review we find at this stage that the present directions of the rivers had been determined, and that the valleys of those days can be recognized and their depths defined by the Kidderminster-Avon No. 4 Terrace, and perhaps by the 'High Terrace' with *Hippopotamus* in the Trent valley. There is, however, one exception to this statement. I refer to the Iron Bridge gorge. This section of the present river was non-existent at this time, and in its place was a high watershed. The diversion of the Upper Severn across this waterparting belongs to the story of the Newer Drifts.

NEWER DRIFTS

(*a*) *The Main Irish Sea Glaciation.* I can only refer in the very briefest way to the events that have occurred since the 'Great Interglacial.' I have already mentioned that the Newer Drifts in the Midlands were the product of the *Main Irish Sea Glacier*, and I have attempted to define its maximum extent on Fig. 1. This glacier belonged to the *Third Glaciation.*

The oncoming of this glacier seems to have coincided with the deepening of the Severn valley below the Kidderminster Terrace level, in preparation, as it were, for the great floods of sand and gravel that were fed into it as soon as the ice crossed the old watershed near Iron Bridge and at the head of the Worfe and Smestow valleys. These deposits are now the Main Terrace, correlatives of which are the Second Terrace of the Avon and probably the low terraces of the Trent and Tame.

As the ice had been moving upstream in its invasion of the Dee and Mersey basins, it must have impounded the drainage during the advance, as we know it did later during the retreat; but there seems to be no record of an overflow into the Severn catchment during this growth stage. As the ice melted back from the maximum position shown on Fig. 1, a series of important drainage changes took place. First, at an early stage when the ice still covered the watershed at Iron Bridge and at the head of the Worfe, but had melted back enough to expose the upper Penk valley, a small lake was impounded just north of Wolverhampton which flowed out south-westwards over the watershed near Tettenhall, forming the Tettenhall Gap. This overflow was responsible for the great train of gravels full of Irish Sea erratics that follows the Smestow Brook down into the Stour.

Dixon has traced various ice fronts trending in a general north-easterly direction across the country between the Penk and Newport, Salop. These are marked by terminal kames and by beaded åsar.

The Worfe valley was an important line of drainage from the ice front until the latter came to lie on the north side of the watershed. In this position a lake was impounded near Newport, and Dixon has shown that this drained across the watershed at Gnosall into the Church Eaton brook and so into the Trent. He named it Lake Newport.

I have elsewhere described the detailed evidence relating to the way in which the waters of the Upper Severn came to be diverted through the Iron Bridge gorge into the drainage basin of the present Middle and Lower Severn. This diversion was brought about during the melting back of the Main Irish Sea Glacier on the watershed region near the Wrekin, through the development of a system of marginal channels and glacial lakes. The detailed evidence substantiates a hypothesis suggested independently by both Lapworth and Harmer, the main feature of which was that a lake was held up by the ice sheet on the north-west side of the pre-Glacial watershed at Iron Bridge; and that this lake drained away across the divide, and thus initiated a gorge that became so deep that it has permanently retained the Upper Severn drainage which formerly went out to sea either by the Dee or by the Mersey. This lake I named Lake Buildwas.

At this stage then there were two lakes, Buildwas and Newport, on the north-west side of the watershed, one draining to the Trent and one to the Middle Severn. They were separated by the ice where it impinged on the Wrekin. When the glacier melted back farther and allowed the lakes to join and form 'Lake Lapworth,' so nearly at the same level were the outlets that it was a mere matter of chance that the Upper Severn went permanently to the Bristol Channel and not to the Humber. As it happened, the Iron Bridge outlet was, or at any rate soon became, the lower. It took all the discharge and has retained it ever since.

These glacial accidents have been the factors that have determined much of the geography of the Midlands; for they diverted into the relatively small pre-Glacial catchment basin of the Lower and Middle Severn great volumes of water which have rejuvenated the river, especially in its middle reaches, on a stupendous scale. The rejuvenation is still operative, and can be seen to-day in the erosive activity of every tributary of the Middle Severn.

Climatic conditions during the Main Irish Sea glaciation were extremely severe. Solifluxion and melt-water floods were on a correspondingly grand scale in the periglacial region. There are vast spreads of local, often angular, detritus at the foot of the Cotteswold and Malvern Hills, and in the valleys draining the high ground of Enville and the Clent-Lickey range, which resulted from these conditions. Most of these grade down to the Main Terrace level in the adjacent valley, and may be correlated with that terrace and thus with the third glaciation; though some seem to be still younger and to correlate with the Worcester Terrace and the Welsh Re-advance.

(*b*) *The Welsh Re-advance* or Little Welsh Glaciation.* The fourth and last glacier to reach our area was an extension of the Upper Severn valley-glacier down as far as Shrewsbury, to which Whitehead has given the name *Welsh Re-advance.* There is strong evidence that the lowest of the important Severn Terraces, the Worcester Terrace, was being formed during this re-advance.

The problem of the Welsh re-advance is one among many relating to our glaciations that await solution, and yet can never be solved by work in one restricted area. The cry is always for accurate data in neighbouring areas. I close this address, as I began it, by an appeal for amateurs who are willing to undertake conscientiously and scientifically the recording and co-ordinating of every scrap of evidence in the district in which they live, whether it be a glacial or a periglacial one. If this were done so carefully that no temporary exposure escaped record, data would gradually, but I think quickly, accumulate by which some at least of the many outstanding problems of glacial correlation and interpretation would reach solution.

* The map, Fig. 1, does not attempt to show the limits of this along the Welsh borderland, as worked out by Dwerryhouse and Miller and by Charlesworth, since they lie wholly outside the Midlands.

The Soviet North Polar Station

WHEN the Soviet polar station was founded on an ice-floe near the North Pole on May 21, 1937, it was expected that the floe would drift slowly, perhaps erratically, but on the whole towards the northern coast of Greenland. The outflow of ice from the Arctic basin by the East Greenland current, the observed westerly drift of floes to the north of Greenland and the heavy hummocky ice off Smith Sound and Grant Land, Nares' misnamed palæocrystic ice, all point to the probability of a more or less rotatory drift within the Arctic basin. There can be little doubt that some of the Arctic pack-ice is carried, at least at times, by such a drift, which is no doubt partly due to the earth's rotation and is assisted by the prevalent atmospheric circulation.

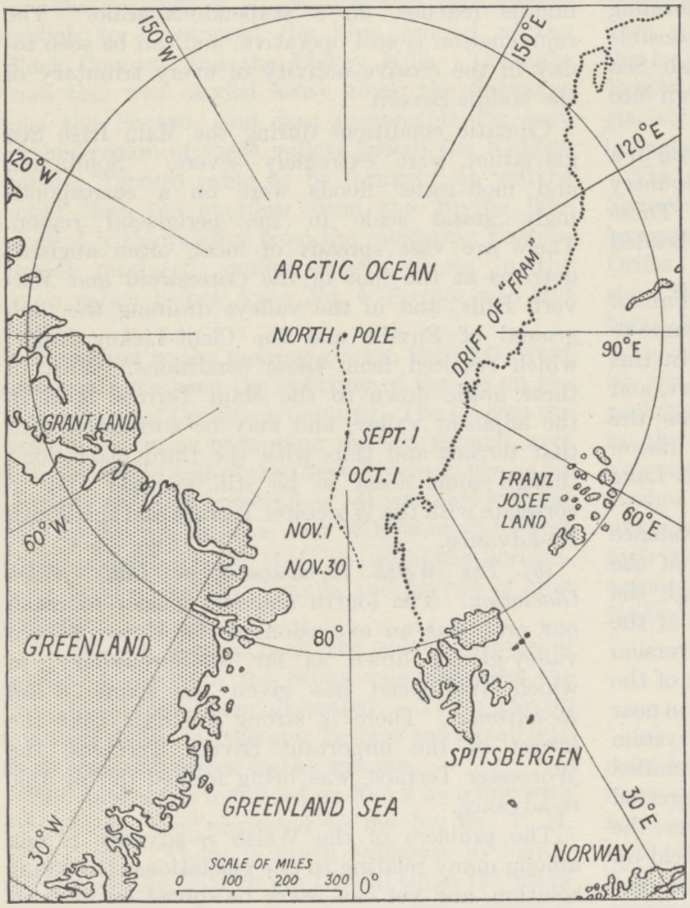

CHART SHOWING DRIFT OF THE SOVIET POLAR STATION (broken line)

The Soviet station, however, has not closely followed the anticipated course. News in *The Times* and the Soviet Union Year Book Press Service give some details. Until early November the drift was steadily southward along the meridian of Greenwich, with deviations of about seven degrees of longitude to east and west. Then during November the course became south-east towards Spitsbergen, and on November 30 the position was lat. 82° 51′ N., long. 7° E. Thus the station is now approaching the course of the final stages of the drift of Nansen's *Fram* in 1896. The *Fram*, with a slower and less decided course, moved on the whole to the south-west from the vicinity of the New Siberian Islands to lat. 84° N., long. 15° E. and then southward. Thus there would appear to be a certain parallelism between the two drifts, with the suggestion that the quicker drift of the Soviet station is due to its being in the main trend of the current while the *Fram* was in the peripheral regions, where wind may at times have controlled the course.

Until November the floe with the Soviet station was moving definitely towards the East Greenland current, which is the main outlet of the ice of the Arctic Ocean. This current may well have been drawing it in that direction. The change of direction in November is more difficult to explain. Possibly wind action may be a factor of some importance as the pack approaches the periphery of the basin and there is less congestion, as is suggested regarding the *Fram's* route, or there may be eddies on the margin of the main stream.

On December 12, however, the floe was reported to be in lat. 82° 8′ N., long. 7° 45′ W., so that it is now moving towards Greenland.

If the drift continues, as seems probable, the position of I. D. Papanin, E. Krenkel, E. L. Federov and P. P. Shirshov will become one of extreme danger, although their wireless messages make light of their peril. Rumblings in their floe indicate cracking: dissolution may quickly follow if the floe reaches the edge of the pack and feels the influence of ocean swell. That will be some time yet, but probably will occur during the winter and not as had been hoped in summer daylight. Until March there will be no daylight at the station: darkness will materially increase the difficulty of aeroplanes finding an adequate landing place for the rescue, and the explorers have no vessel. There are reports that the Soviet Government intends to send an ice-breaker to the rescue. This plan holds out more hope. On the other hand, the floe may continue its drift towards north-east Greenland. In that event the explorers may be able to effect their own rescue by travelling over closely packed ice, held by the land, to the safety of the shore. It is much to be hoped that these gallant men, who have risked much in the cause of scientific investigation, succeed in reaching safety. Up to the present, their meteorological records alone have been published, but it is clear that the ocean soundings are going to prove of great interest, as showing a uniformity of depths in high latitudes and defining the width and depths of the ridge connecting Greenland and Spitsbergen. Other oceanographical discoveries were referred to in a previous article in NATURE (**139**, 990, June 12, 1937).

R. N. R. B.

Obituary Notices

Sir Jagadis Chandra Bose, C.S.I., C.I.E., F.R.S.

BY the death of Sir Jagadis Chandra Bose on November 23, a few days before his seventy-ninth birthday, India has lost one of her foremost sons and science one of its most picturesque figures. In India, and indeed elsewhere, Bose's concern for the well-being and progress of his native country has for long been widely known. His reputation as a physicist has been established for several decades. But it is at present not possible, and will not be possible for some time to come, to assess the true value of his contributions to physiology.

Bose's physiological work still remains in an isolated position in spite of decades of indefatigable work on his part, many volumes of published experimental work, and sometimes even unique facilities granted, not only in his own country, but also in Great Britain, the United States and on the Continent, to bring his results personally before the public by means of lectures and demonstrations. (In his earlier days, such facilities were not always available, and it is a tribute to his fighting instinct that he was able to obtain them in the end.)

The reasons for Bose's isolated position in the science of physiology are many and varied. Although he was a pioneer in his own field, he seldom discussed his results with those of his contemporaries. His scientific work was at times almost dramatic, with the result that even at the early stages he attracted much attention from the non-scientific world. Diplomats and high Government officials attended his discourses; Romain Rolland was loud in his praises of him; Rabindra Tagore wrote poems eulogizing his work; and Bernard Shaw was attracted to one of his lectures. Naturally, lay publicity and interest followed such distinguished example; but all this was unhealthy to Bose, the man of science, when so little of his work had received scientific confirmation.

Jagadis Chandra Bose was born in the village of Rarukhal in Vikrampur, a large area in the Dacca District, on November 30, 1858, the son of Bhagaban Chandra Bose. But Bose's father soon migrated as deputy magistrate to Faridpur, the centre of the next District, and it was there that Bose spent his childhood days. Bhagaban Chandra Bose had a profound sense of public duty, and it was doubtless from this source that Jagadis Chandra Bose's supreme love and work for his fellow countrymen had their origin. Bose's father, too, had to grapple with the severe problem of the dacoits in his area, and his success won unstinted praise from the authorities. Such factors were no doubt operative in eliciting that note of strenuous and persistent courage in facing adversities and of untiring combativeness against every difficulty so inherent in Jagadis's character throughout his life.

By his father's wish, Bose received his primary education at the vernacular school in Faridpur, and not the English school. Thus did he at an early age come into contact with the problems of the peasant, and those problems always occupied his mind afterwards. At nine years of age he entered St. Xavier's School in Calcutta, where his taste for natural history veered round to one for physics under the influence of Father Lafont. He graduated B.A. at the age of twenty years.

At this time, his family was financially embarrassed, but chiefly through the help of his mother, Bose was enabled to leave Calcutta for the University of London to study medicine. In later years, he was never tired of describing the thrills he experienced in studying zoology for the first time under Ray Lankester. But his health forced him to leave London, and, having gained a natural science scholarship, he entered Christ's College, Cambridge, in 1881. His first year there was one of indecision, but he was an assiduous student of physiology under Michael Foster and embryology under Francis Balfour. In his second year, he settled down finally to botany under Vines and Francis Darwin, chemistry under Liveing and physics under Rayleigh. He took the Natural Sciences Tripos, obtained his B.A. and at the same time took a London B.Sc. In later years, his former teachers, Lord Rayleigh and Prof. Vines, were appreciative of his researches in physics and physiology, and were sponsors for their presentation before the Royal and Linnean Societies respectively.

Bose returned to India at the age of twenty-five years, and, after serious opposition from the Educational Service and from academic authorities, was appointed professor of physics in Presidency College, Calcutta. Here his lectures were brilliant and his influence over the students profound. Thus finally did he gain the full approbation of the Principal of his College and the Director of Public Instruction.

Having thus overcome preliminary opposition and difficulties (though there were many more in store), Bose determined that henceforth his life should be devoted not to professional survival or family honour, but to the pursuit of scientific truth. How tenaciously he adhered to that resolution throughout his career is practically common knowledge. Through it, especially in his own country, he won the love and admiration of everyone.

Bose's first researches were on electric radiation, and within a year the Royal Society undertook the publication of his investigations and provided financial help for their continuation. About the same time he was awarded the degree of D.Sc. in the University of London. Thus did his first piece of research work win authoritative approval. Kelvin too was enthusiastic in his praises of Bose's physical researches : but all this meant chiefly one thing to Bose—that India was coming forward in scientific research. So at that time he decided that India should have its own scientific research institute : but he was still faced with much opposition so he concluded that anything done in such a direction must be done by himself. However, it was not until another twenty-five years had passed, during which both he and his wife practised the strictest economy, that he was able to realize his dream and open the Bose Research Institute in Calcutta.

Having justified his claim as a physicist, Bose received every encouragement from his own Government and from the Imperial Government.

About the same time that Lodge was extending Hertz's work on electrical radiation in England, Bose was doing similar work in India. With his perfected apparatus, he carried out his now familiar work on electric waves. He was able to verify the laws of reflection and refraction, determine refractive indices and wave-lengths (by curved gratings) and exhibit polarization and double refraction by pressure and unequal heating. In 1896, this work received the highest praise from Sir Oliver Lodge and Lord Kelvin, and Bose was acclaimed as the first Indian to win distinction through scientific work. On the Continent and throughout Asia, too, his work in physics received distinct approval from such men as Lippmann, Quincke, Warburg, Lenard and others, and as the outcome of it all, British men of science, including Lister, Kelvin, Dr. Gladstone, Poynting, Stokes, Silvanus Thompson successfully appealed to the Government to establish a well-equipped physical laboratory in Presidency College. But there was much delay, and the laboratory did not materialize until 1914, shortly before Bose retired from the chair. Further experiments with his electric refractometer were communicated to the Royal Society in 1898 when he described determinations of the indices of refraction of various substances and the influence of the thickness of the air-space on total reflection of electric radiation. In 1900 he contributed a communication to the Royal Society on molecular changes produced in matter by electric waves, in which he made some interesting observations concerning the phenomenon of fatigue in metals. This marked the beginning of his interest in response in the inorganic and in the living.

At the beginning of this century, Bose's well-known, though little understood, work in physiology began, and he read his first paper on the response of inorganic and living matter before the International Conference of Physics meeting in Paris in 1900. This paper caused considerable discussion, and he read a similar paper at the British Association meeting at Bradford in the same year. Here he described the magnitudes of changes produced in the molecular structure of inorganic and living substances due to an electric stimulus, and was able to show that from this point of view both types of substances are similar. On this basis, he constructed an artificial retina that enabled him to explain many phenomena of vision which up to that time had been obscure. Both physicists and physiologists attended this paper ; the physicists were enthusiastic, but the physiologists were cool.

At the invitation of Rayleigh and Dewar, Bose continued his researches along these lines in the Davy Faraday Laboratory of the Royal Institution. He then returned to India. Though during 1900–3 he continued his researches both in England and in India on the theme of response in the inorganic and the living and had his papers read before the Royal Society, they were not published owing to the opposition of some physiologists. A paper was read before the Linnean Society of London under the sponsorship of Vines, Horace Brown and Howes. In this he discussed the electric responses in ordinary plants under mechanical stimulus. His experimental results showed, he claimed, that the response of the ordinary plant organism, so far as fatigue, temperature, poisons, anæsthetics, etc., are concerned, is identical with that of animal muscle and nerve. Similar results communicated to the Royal Society in 1903 were not published. But from 1902 until 1919 he published six volumes of his experimental investigations and conclusions and many papers on his 'physics of physiology'. In his "Responses in the Living and Non-Living" he claimed to have demonstrated "a complete parallelism . . . between plant response on the one hand and that of animal tissue on the other" and, referring back to his earlier physical experiments on the 'electric eye' he claimed to have shown that "there is not a single phenomenon in the responses, normal and abnormal, of the retina which has not its counterpart in the sensitive cell constructed of inorganic material".

Thus did Bose's earlier work in physiology meet with much active opposition : but this gradually subsided and eventually some of his work appeared in the publications of the Royal Society and other societies. On November 30, 1917, he was able to realize his dream of a quarter of a century and open the Bose Research Institute in Calcutta. This includes departments of physics and plant and animal physiology. Active research continues there. The funds were supplied by him and from Government grants.

Bose had a genius for designing delicate and sensitive apparatus for his physiological investigations, fertility in initiating new lines for observation and a clear style of setting out his experimental results and theoretical deductions. Nevertheless, by his resonant recorder and oscillating recorder he actually did for the first time record the delicate movements of leaves of *Mimosa* and *Biophytum* without distortion. He also devised apparatus for demonstrating the effect of sleep, air, food, drugs, excitation, impulse, etc., on plants. He also demonstrated an instantaneous record of growth and death. Thus, according to him, did the plant automatically record its own physiological life-history. In 1919, he announced that he had obtained in plants very definite mechanical and electrical response to wireless impulses, and claimed that the "perceptual range of the plant is inconceivably greater than ours: it not only perceives but also responds to the different rays of the vast æthereal spectrum". His high-magnification crescograph which magnified the growth of a plant ten million times was received with enthusiasm in England in 1919–20. Doubt had originally been cast on the crescograph really recording growth magnification, but after demonstrating his apparatus in University College, London, a letter appeared in *The Times* of May 4, 1920, over the signatures of some of the leading British men of science stating that "the growth of plant tissues is correctly recorded by this instrument and at a magnification of from one to ten million times".

Bose received the C.I.E. for his scientific work at the Delhi Durbar in 1902. In 1911 he was awarded the C.S.I., and in 1915 he retired from the chair in Presidency College as emeritus professor on full pay. In 1917 a knighthood was conferred upon him, and in 1920 he was elected a fellow of the Royal Society.

Comment on Bose's praiseworthy work in physics would be superfluous: but he would be a daring man who attempted any precise evaluation of Bose's work in plant physiology at this stage. His work was prolific and his publications voluminous. He published a large number of books, and the "Transactions of the Bose Research Institute" contain much of his own work and much carried out in collaboration with others. Most of this work has been received in silence, and has neither been confirmed nor openly refuted. In any event, never will it be truthfully said that Bose was not a potent stimulus to contemporary physiologists, especially at the height of his career. A leading physiologist once said that Bose's "more general conclusions will probably not attract so much attention as the new experimental methods he employed". But the application of Bose's methods in experimental physiology by other investigators is still to come.

Of Bose, the man, nothing but the most gracious and kindest thoughts can be entertained. He was a great patriot and took a deep interest in Indian culture; and his wider interests are shown by his former membership of the International Committee on Intellectual Co-operation of the League of Nations. Sir Jagadis is survived by Lady Bose, who for many years was a source of encouragement to him.

Dr. K. J. Saunders

DR. KENNETH J. SAUNDERS, whose death at the age of fifty-three years occurred at Eastbourne on November 22, was an orientalist and authority on the religions of Asia of no little distinction.

Dr. Saunders was educated at Clifton College and Emmanuel College, Cambridge, of which University he was a D.Litt. From 1909 until 1912 he was a lecturer of Trinity College, Kandy, and it was in this period, through his contact with the Buddhist monks of Ceylon, that he acquired an insight into the practical working of the Buddhist faith. This determined his line of approach to the comparative study of the religions of the East as 'ways of life', which he demonstrated most strikingly in his studies of similarities in the doctrines of Buddhism and the teachings of Christ. He was also strongly impressed by the influence of Buddhism in the spread of the culture of India and Ceylon to other countries in Asia. These views on the place of Buddhism in the life and culture of the East were strengthened by a period of residence in Burma, when work for the Y.M.C.A. brought him into intimate contact with native students; and they were confirmed and deepened by pilgrimages to Buddhist shrines and centres in other parts of Asia, especially China and Japan, which he visited after the Great War.

Dr. Saunders was later appointed to the chair of comparative religions in Berkeley University, California, which he held until 1935. In the two following years, he was engaged in lecturing on Asiatic history; but a breakdown in health prevented him from taking up his duties on appointment to the recently founded Spalding chair for the study of comparative religions in the University of Oxford.

WE regret to announce the following deaths:

Dr. O. C. Bradley, principal of the Royal (Dick) Veterinary College, Edinburgh, since 1911, on November 21, aged sixty-five years.

Mr. Edward T. Browne, a governor of the Marine Biological Association of the United Kingdom and a generous benefactor to science, well known for his zoological work on medusæ, on December 10, aged seventy-two years.

Prof. J. Henderson, professor of natural history in the Colorado Museum, an authority on invertebrate palæontology, on November 4, aged seventy-two years.

The Rev. Walter Howchin, emeritus professor of geology in the University of Adelaide, aged ninety-two years.

Prof. A. Hutchinson, O.B.E., F.R.S., formerly professor of mineralogy in the University of Cambridge, lately master of Pembroke College, on December 12, aged seventy-one years.

Prof. Hans Molisch, formerly professor of botany in the University of Prague, on December 8, aged eighty-one years.

Mr. George Philip, chairman of Messrs. George Philip and Son, Ltd., geographical publishers, and author of several valuable library atlases, on December 8, aged sixty-seven years.

News and Views

Population Statistics

SIR KINGSLEY WOOD, the Minister of Health, has taken to heart the criticisms of the schedule of the Population (Statistics) Bill which have been brought forward, both in and out of Parliament, since its publication. The revised schedule omits altogether the comprehensive Clause 3, which made it possible to demand information upon "any other matter", and was much disliked. The questions now to be asked are definite and simple. On registration of birth : the age of the mother ; the date of marriage ; the number of former children of the mother. On registration of death : whether the deceased was married ; if a woman, the date and duration of marriage ; the number of children ; the age of the surviving spouse. The information so obtained will not be disclosed to the public. These are not provocative questions and it may be expected that they will be approved by Parliament. The history of this Bill shows our democratic institutions at their best. We have, first, a Bill with a vague and complex schedule, calculated to give rise to objections, and covering more ground than was really required ; then an excellent, critical debate in the House of Commons, and a good, general discussion in the newspapers ; and, finally, the revision and simplification of the Bill by a sensible Minister.

Air Raid Precautions

IN his speech on the motion for the third reading of the Air Raid Precautions Bill in the House of Commons on December 7, Sir Samuel Hoare emphasized that air raid precautions, on however great a scale, cannot assure complete immunity to the population of Great Britain or any other highly industrialized European country. The most that can be done is to minimize the catastrophe and loss of life and to ensure the essential defence service. It is also impossible to concentrate on passive defence a disproportionate amount of money and man-power. Air raid precautions have their proper place in a general scheme of defence finance and preparation, and Sir Samuel expressed the opinion that the execution of the Government's plans would go far to prevent panic and ensure the continuance of the essential services. When the Bill reached the Statute Book the Government proposed to make much greater use of experiments in co-operation with local authorities and to strengthen the air raid precautions organization of the Home Office. In addition, very considerable steps are already being taken in Government Departments to organize air raid precautionary methods. About fifty instructors drawn from different departments have received training at the civilian anti-gas school and are giving instruction to the staffs of departments. About eighty instructors trained in the same manner have been supplied to the Post Office, and it is hoped by the end of the year that there will be more than 150 instructors in the Post Office service alone. Seven gas chambers are being constructed in various Government buildings in the London area by the Office of Works, and the Office is also carrying out an extensive structural survey of existing Government buildings. The most suitable accommodation will be ear-marked for refuges to which the staff will be collected on receipt of an air raid warning.

STRUCTURAL precautions against air attack will be considered in all new Government buildings, and in the new Whitehall buildings it is proposed to construct a roof of solid concrete to resist small incendiary bombs and some resistance to penetration of high explosive bombs generally. The solid concrete floors would offer further resistance to bombs which penetrated the roof, while the second floor below the roof would be strongly reinforced to retain debris if the top floors collapsed. A strongly reinforced floor would also be provided on the ground floor level to provide protection for staff collected in the emergency refuge accommodation in the basement. Interesting to scientific workers as are these details of Government plans, they will equally welcome Sir Samuel Hoare's frank admission of the limitations of air raid precautions and his reminder that the very precautions proposed run counter to the ideals and chief movements developed in civilized life after generations of progress. In protective clothing, lighting, evacuation, we are setting the clock back for generations, and Sir Samuel Hoare averred the Government's determination to lose no opportunity of trying to reintroduce sanity into the world and remove the conditions which have made such provisions inevitable.

Administration and the Aborigines of Australia

CORROBORATION in part of recent criticism of the treatment of the Australian aborigines (see p. 1029 of this issue of NATURE) comes from a source carrying a weight that cannot be disputed. Dr. Donald Thomson, an anthropologist appointed by the Federal Government to act as a special patrol officer in Arnhem Land, now relinquishing his post to take up a Rockefeller Foundation fellowship at Cambridge, has made a statement, according to the Canberra correspondent of *The Times* in the issue of December 9, in which he comments severely on the policy in aboriginal administration being pursued in the Northern Territories. His criticism, as reported, is directed mainly against encroachment on native lands. In the selection of Groote Eylandt as a flying-boat base, he maintains, every interest but that of the aborigines has been considered. It seals the doom of a tribe of three hundred aborigines, "in many ways the pick of the surviving Australian tribes"—a view which anthropologists conversant with the Australian material will endorse. He went on to state that the Arnhem Land Reservation is no reservation at all. It is being encroached upon in many ways, the natives are diminishing rapidly, while two watering places for pearlers, which have been established on the coast, are destined to be 'plague spots' which will extend throughout the reserve. That criticism is not entirely ill-directed has been admitted by Mr. Lyons, the Prime Minister, who, while deprecating exaggeration, concedes that there is room for improvement—indeed that improvement is "imperative and urgent". He announces his intention of calling an early conference of Federal and State representatives to consider the future of the aborigines.

Mr. G. O. Harrison

MANY graduates of the University of Birmingham will be interested to learn that Mr. G. O. Harrison, chief workshop assistant in the Physics Department, is retiring after nearly fifty years service. Mr. Harrison began as laboratory boy to Prof. J. H. Poynting when the latter was engaged on his gravitational experiments at Mason College. When Röntgen discovered X-rays, Mr. Harrison, on the instructions of Prof. Poynting, made the first X-ray tube constructed in the Birmingham district and successfully used it to make a radiogram of Poynting's hand. For the next two years, the Physics Department, with Mr. Harrison as radiographer, became a centre to which the hospitals of the city sent patients to be 'X-rayed', the well-known surgeon Jordan Lloyd being one of the first to avail himself of the new facility for seeing the 'insides' of his patients. The rays were also applied to dentistry, the method employed being very like that in general use to-day. In the course of this work, Mr. Harrison discovered that X-rays could be seen, that is, that they produced on the retina (suitably prepared by darkness) the effect of light, shadows of interposed metal objects being clearly distinguishable. This formed the subject of a letter to NATURE (July 15, 1897, p. 248). Mr. Harrison's skill as a glass-blower and his versatility as an instrument maker have been of great value to a long series of research workers in the Physics Department, whose good wishes will go with him in his retirement.

New Surgical Research Laboratories

THE Bernhard Baron Laboratories of the Royal College of Surgeons of England were opened by the Earl of Athlone on December 8. These laboratories, which occupy the fourth, fifth and sixth floors of the main College building, were made possible by a gift of £30,000 from the Bernhard Baron Trust. The object of the laboratories is to provide facilities for experimental work on problems bearing on surgical diagnosis and treatment and for the investigation by experimental methods of more fundamental biological problems. In addition to six large laboratories, the research unit is provided with complete animal accommodation, a fully equipped operating theatre, X-ray and photographic rooms and a pathological laboratory. The laboratories are furnished with movable units, which allow of the remodelling of the laboratories to suit the individual requirements of those who use them. One of the most interesting features is the use which has been made in the building of Empire timber for furnishing, flooring, etc. Ample provision is made for twenty research workers, and the staff accommodation is well arranged on the sixth floor, which leaves the floor below a complete research unit. Pathological, X-ray and photographic rooms are on the fourth floor. The detailed equipment of the research rooms is interesting. Use is made of gas plugs instead of gas taps, electric power and light outlets are grouped in such a way as to facilitate the assembly of electrical equipment for experimental work. The operating theatre has been designed as a model theatre for animal work, and is completely equipped with modern steam sterilizing plant, X-ray viewing screens, diathermy and telephone installation.

Visual Purple and Vision

DR. R. J. LYTHGOE delivered the Thomas Young Oration of the Physical Society, entitled "The Structure of the Retina and the Role of its Visual Purple", on December 9. The key to the understanding of the processes by which the energy of a light wave causes impulses in the optic nerve lies in the retina. It is found that about 400 rods of the retina must be served by one nerve fibre after the demands of the cones, the organs for visual acuity, have been satisfied. The conger and other deep-sea fishes have retinæ almost exclusively composed of rods, and these rods are fine and filamentous. The fineness of the rods in the conger's retina cannot result in a higher resolving power of its eye, since some 1,600 rods must be attached to one nerve fibre. It is suggested that visual purple, the light-sensitive substance found in the rods, is adsorbed on their surfaces and that the large number of rods in the conger, by increasing the quantity of visual purple, improves the animal's vision at low illuminations. The increase in visual purple will not have a great effect on animals living at very great depths where only a narrow band of wave-lengths is transmitted. Deep-sea fishes also improve their vision at low illuminations in other ways, namely, by having large aperture eyes and also by the movements of pigment which protect the rods and their visual purple during exposure to light. The eyes of the monkeys have been shown to possess a remarkable adaptation to habit, day-hunting species having a cone type of retina, night-hunting forms having mostly rods, whilst in addition the retina is lined with tapetum, which appears to act by reflecting light back on to the rods. Recent work on visual purple has shown that the quantum efficiency of the bleaching process is about unity, and in addition visual purple has a high extinction coefficient. The 'bleaching' of visual purple by light results in the production of a yellow substance, and there are probably other intermediate products. The presence of these coloured breakdown products in high concentration might considerably modify the perception of light of different wave-lengths.

Estuary Channels and Embankments

IN the Vernon-Harcourt Lecture delivered at the Institution of Civil Engineers on December 8, Dr. Brysson Cunningham discussed "Estuary Channels and Embankments". The two chief objects of the engineering treatment of estuaries are the regulation and improvement of the navigable channel and the protection of adjacent low-lying land from tidal inundation. From the point of view of navigation, defects arise from three main causes : (1) a shifting, unstable channel ; (2) a narrow bed, with inadequate depth of water ; and (3) a bar. In carrying out estuary training works for the removal or amelioration of the first defect, certain principles have to be observed in order to avoid risks and possibilities involved in the confinement of the stream within a definite course. The design of different types of wall was considered by Dr. Cunningham. As regards shallowness of the river bed, the principal remedy, although not of a permanent nature, is dredging by means of floating plant of various types. The cause and origin of bars were next discussed, and the peculiar conditions attached to dredging operations in exposed situations were set out with particulars of some of the latest and largest dredgers engaged on that class of work. Dealing with estuary embankments, Dr. Cunningham pointed out that in the case of the Thames alone, there are more than 40,000 acres of serviceable marshland, utilized for a variety of purposes, which have to be protected at high water in this way, while, in the maritime provinces of Holland, whole districts lie so low as to be permanently below sea-level. The embankments on the Thames, the Trent and at the mouths of the Schelde and the Maas were illustrated and the nature of their construction explained, including the design of sluices for dealing with the drainage of inland water.

Television on a Large Screen

ACCORDING to reports in *The Times* of December 8 and 10, two demonstrations have been given recently of the reproduction of the London television programmes on a large screen. In the first case, Mr. J. L. Baird showed the B.B.C. television programme on a large cinema screen. The receiver utilized a cathode ray tube, on the luminescent screen of which a small picture, 2 in. square, was first formed. This was then projected optically on to the large screen to give a picture about 8 ft. by 6 ft. At all times the picture, it is stated, was quite clear as viewed from both the front and the back of the theatre ; the focus was good and there was never sufficient interference to disturb the enjoyment of the audience. The second demonstration was given by Messrs. Scophony Ltd., using the pioneer optico-mechanical methods developed by that company. In this case, two receivers were available, one giving a screen picture 6 ft. by 5 ft. suitable for a medium-size hall, and the other being a home receiver providing a picture 2 ft. square. The first receiver was demonstrated to a large audience, who saw a very acceptable reproduction of the afternoon television programme. The pictures were free from flicker and were bright enough to be seen in comfort by everyone present. It seems likely that these two demonstrations will mark a new stage in the progress of the technique of television reproduction.

Thermionic Valve Data

THE modern thermionic valve has now become of world-wide importance, not only in connexion with radio broadcasting, but also in its many applications in scientific and commercial instruments, and in industrial processes. Unfortunately for those who have to make constant use of valves of the usual receiving type, their popularity and rapid advances during the past decade have resulted in a multifarious range of valves for different purposes. In spite of several earnest attempts, no satisfactory means of classifying these valves has been standardized, and the various manufacturers have accordingly adopted different and arbitrary codes for designating the types of valves which they supply. Amidst this confusion and in the absence of adequate co-operation between manufacturers in different countries, it is natural to find that the number of types is constantly increasing and is now quite unnecessarily large. Pending the time when more uniformity is arrived at, however, the *Wireless World* has been fulfilling a useful public service for the past ten years by issuing a list of valve types with the appropriate technical data. A search through these lists reveals in a striking manner not only the growth in the number of valves, but also the increasing amount of information which is needed about a valve in order to select a suitable type for any purpose. The issue of the *Wireless World* of November 25 contains the latest of these lists in the form of a nineteen-page supplement. The data here provided cover more than 900 current valve types, both British and American, as many as fourteen numerical characteristics being given for some of the valves. A useful guide to valve bases is also provided. Such a publication cannot fail to be of great utility to all scientific and technical workers who make use of the modern thermionic valve.

Accessions to the British Museum (Bloomsbury)

AMONG the accessions to the collections of the British Museum (Bloomsbury) announced in December are a number of antiquities from the Near East and Egypt. Of these, among the more noteworthy are those obtained by Mr. M. E. L. Mallowan's excavations of last season on sites in northern Syria. Clay tablets from Chager Bazar, dating from about 2000–1900 B.C., deal with accounts, mostly relating to corn. Although the names of the months are Babylonian, the tablets appear to indicate that the district was then under the dominion of Assyria. Objects from another site, Brak, are of considerable importance in the prehistory of western Asia, as they include black-on-white pottery, similar to that found by Sir Leonard Woolley at Atchana near the mouth of the Orontes, and bearing out his conclusion as to the international importance of that region as an emporium linking the Mediterranean and the

(*Continued on page* 1055)

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SUPPLEMENT

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Further Tributes to the late Lord Rutherford

Prof. Stefan Meyer

Institute of Radium Research, Vienna

THE world is poorer through the passing away of its leader in radioactivity and nuclear physics, Lord Rutherford, who was a unique personality, and what every single one of us has lost scientifically and personally is impossible to say in words. But asked to add a personal contribution to the tribute in NATURE, I am glad to be allowed to tell how much he was admired and loved in Austria.

Schweidler's and my first contact with him dates from the beginnings of radioactivity, when he was in Montreal. The deflection of Becquerel rays by a magnetic field, discovered in Vienna in 1899, was one of the foundations for his classification of these rays, and led to a correspondence that was never interrupted. We remember with pleasure his congratulations when a few years later we succeeded in proving the identity of the long-lived induced radioactivity with radio-lead and polonium as he had predicted. Our first personal meeting was in 1910, at the Congress of Radiology in Brussels. There, international co-operation in radioactivity was inaugurated and the International Radium Standards Committee set up, the members being B. B. Boltwood, M. Curie, A. Debierne, A. S. Eve, H. Geitel, O. Hahn, St. Meyer, E. Rutherford, E. Schweidler and F. Soddy. This Committee, which after the death of H. Geitel, B. B. Boltwood and M. Curie, and after F. Soddy's resignation, with H. Geiger, S. C. Lind, J. Chadwick, I. Curie-Joliot, J. Joliot, O. Hönigschmid and A. Piccard as respective successors, survived all troubles of the Great War and the following years, and Rutherford always expressed his conviction that the Committee ought to continue. He was president of the Committee, and so late as April 1937 he signed two certificates for the new Washington standards. The first consequence of the constitution of the Committee was a meeting in Paris in 1912, which was attended by M. Curie, A. Debierne, O. Hahn, St. Meyer, E. Rutherford, E. Schweidler and F. Soddy. There, quite pure radium preparations, obtained from Paris and Vienna, were compared and the primary standards designated, a fact as important for radioactivity as the creation of the standards of the metre and kilogram.

In the summer of 1913, Rutherford, accompanied by his wife and B. B. Boltwood, visited me in Bad Ischl, where also Hönigschmid, Mache and Schweidler from Vienna had assembled. I think it was his only stay in Austria, and he enjoyed the country and the people on his trips in his car. The 'Dirndl' costumes in Ischl, which caused his chauffeur to ask what race lived in Austria, and a Tyrolese hat Boltwood bought and wore continually, were a source of unending amusement for him. At that time we wanted to organize a radiological congress in Vienna for 1915. The War prevented the realization of this plan, but it could not loosen the friendly relations between Lord Rutherford and Viennese physicists. In the same way as at that time R. W. Lawson was enabled to continue his work at the Vienna Radium Institute, Rutherford did his best to procure concessions for our compatriots in England.

The Vienna Academy of Sciences can be proud of having appreciated at an early date Rutherford's exceptional genius. The Academy so early as 1908 helped him in his work by the loan of 300 mgm. radium free of cost. In 1912 he was made corresponding member, and in 1928 honorary member. After the War it seemed as though the radium preparations still in the possession of Rutherford would be confiscated as 'enemy property'. After prolonged correspondence, Rutherford got the preparations released (1921). In 1927, when the financial difficulties of the Vienna institutes were at their climax, he bought the radium and so enabled research in Vienna to be carried on for some time. Already in 1921 he had written to me : "There seems a growing sense in our governors that it is about time they tried to help all countries to get on their feet again" ; and in 1927 he wrote : "I am very sensible of the generosity shown by the Vienna Academy of Sciences and the Austrian Government in loaning me such a valuable preparation for such a long period. The use of the material has rendered possible the long series of investigations in Radioactivity by myself and my students and has been an invaluable aid in my researches". Again, when he had bought the preparation, he said : "I hope in this way to show my appreciation of the generosity of the Vienna Academy and also to help the Radium Institute to continue its radioactive investigations".

I saw Lord Rutherford for the last time in 1932 in full vitality in Münster, where the whole session of the Bunsen Gesellschaft was under the spell of his personality. In the following years he received my daughter and my son in the kindliest manner in Cambridge, in spite of the numerous claims on his time, and gave them many proofs of his friendly feelings. Whoever came in close contact with him will cherish the memory of how he attracted all, not only through his surpassing scientific greatness, but also through his human kindness and personal charm.

Prof. A. Norman Shaw

McGill University, Montreal*

MEN of science the world over are mourning the death of Lord Rutherford, one of the greatest discoverers of all time.

McGill graduates are feeling an additional personal loss. His former students have for long been proud to recall that they received training and inspiration from the greatest of all McGill professors. The fact that Rutherford laid the foundations of his major work when here has lent an added prestige to McGill University throughout the world, and created an unending stimulus for his successors. At McGill he was given his first opportunity for leadership in research, and the degrees we gave him marked more truly the graduation of McGill under his influence with a new and higher degree of science.

Rutherford was responsible for the greatest outburst of original investigation which has occurred in Canada. For several years brilliant scientific papers on discoveries in radioactivity and atomic physics poured out at the rate of nearly one a month from the able group which had gathered around him from centres as far apart as Poland, Germany, France, England and the United States. The influence of his work and ideals soon penetrated into all walks of science in Canada, increasing the demand for higher scientific training and investigation.

Old friends and pupils of Rutherford have memories even more deeply cherished than the recollections of his work itself. His lively humour, boyish zeal, and kindly human interest in the affairs of those around him, his untiring help in time of need, that remarkable driving ability by which he could obtain almost incessant work willingly given, his uncanny and unerring instinct for the next best step, his hatred of pretence and untested generalization, his outspoken frankness, his uniform fair dealing, his capacity to pick able men and later place them in their life's work, his friendliness and approachability, his dominating voice and personality when deeply stirred—these attributes and more will be recalled as hall-marks of one man, Ernest Rutherford. In our lifetime we shall not see his like again.

*From a message printed in the *McGill Graduates' Bulletin*.

Prof. Niels Bohr, For.Mem.R.S.

University of Copenhagen

I AM thankful for the invitation of the Editor of NATURE to write a few words about my relations with Lord Rutherford that have been so decisive for my work and have filled so large a place in my life. Indeed, neither in the short article about Rutherford's relationship to his pupils, which I had the pleasure of contributing to the Cavendish Laboratory Supplement to NATURE of December 19

1926, nor in the short tribute to Rutherford's memory, which I had the sad duty of giving at the Galvani Congress on the announcement of his untimely death and which appeared in NATURE of October 30, 1937, did I find opportunity to give a proper expression of my personal indebtedness to him, who was to me everything that an inspiring leader and a fatherly friend could be.

From the moment I was admitted into the group of students from very different parts of the world working under Rutherford's guidance in his laboratory in Manchester, he has to me appeared as the very incarnation of the spirit of research. Respect and admiration are words too poor to describe the way his pupils regarded the man whose discoveries were the basis of the whole development in which they were enthusiastically striving to partake. What we felt was rather a boundless trust in the soundness of his judgment, which, animated with his cheerfulness and good will, was the fertile soil from which even the smallest germ in our minds drew its force to grow and flourish. His simplicity and disregard of all external appearance perhaps never disclosed themselves more spontaneously than in discussions with his students, who were through his straightforwardness even tempted in youthful eagerness to forget with whom they were talking until, by some small remark, the point of which they often first fully understood after they had left him, they were reminded of the power and penetration of his insight.

The stimulus Rutherford gave his pupils was, however, in no way limited to times of daily intercourse. Thus when, returned to Denmark, I pursued the line of work which I had taken up in Manchester, it was to me a most encouraging feeling to know that I could always count on his warm interest and invaluable advice. Indeed, looking through our correspondence from those days, I can hardly realize how in the midst of all his work he could find time and patience to answer in the kindest and most understanding way any letter with which a young man dared to augment his troubles. Especially close our relations became during my stay for the first years of the Great War as lecturer in Manchester and when, in times full of anxieties, he kept up the spirits of the small group left in the laboratory and, in the short moments of leisure from the great practical duties entrusted upon him, steadily went on preparing the road to new discoveries which should soon lead to such great results.

In later years, it was each time to me the greatest source of renewed encouragement to visit him in his home in Cambridge, where, in spite of never-ceasing work and an ever heavier burden of duties, he shared so quiet and simple a life with the companion who, always in contact with what was deepest in his character, from early days stood by him in every joy and sorrow. With age the vigour of his spirit did not abate, but found outlet in ever new ways, and his genial understanding and sympathy with all honest human endeavour gave to his advice in any scientific or practical matter a value treasured in wider and wider circles. To every one of us to whom he extended his staunch and faithful friendship an approving smile or a humorous admonition from him was enough to warm our hearts, and for the rest of our lives the thought of him will remain to inspire and guide us.

Prof. G. Hevesy

University of Copenhagen

WHEN, early in 1911, I had the privilege of joining the Langworthy Laboratory of Physics in the University of Manchester, that part of radioactivity which may be called the classical one was approaching completion. The sequence in the three series of disintegrations and the life-period of their members had with but few exceptions been already ascertained, mainly by the work of Rutherford and his pupils. This very laborious task, often requiring for its performance much ingenuity, was initiated by the theory of successive transformations put forward by Rutherford and Soddy in 1902; this proved to be the fundamental theory of radioactive research. The successful completion of the main task of classical radioactive research further enhanced the great authority of the leader of the Laboratory and the spirit of contentment prevailing in the Laboratory.

The chapter on the properties of the radioactive radiation, though greatly advanced in those years, was far from being complete. Rutherford, although he personally carried out experiments on the heating effect of radium and its emanation with the assistance of his faithful and able laboratory steward, Kay, and encouraged all the numerous researches going on in his laboratory, concentrated his interest chiefly on the experiments on α-particles. Of all Rutherford's spiritual children, none was more deeply loved by him than the α-particle, and none requited his affection more generously. The conception of the nuclear atom was put forward by him on the basis of the experimental results on the scattering of the α-particles obtained by Geiger and Marsden. In witnessing the birth of this conception, his pupils had a unique opportunity of seeing the working of Rutherford's great mind. To be struck by the remarkable behaviour of a tiny percentage of the α-particles investigated, to ascertain that the observed effect was genuine, to ask for a reason which would account for the effect and to accept the most straightforward solution, was a typical sequence of the truly 'Rutherfordian' way of picking out and solving problems.

In a recent speech at Guildhall, Lord Baldwin characterized his fellow countrymen as being profoundly distrustful of the men called clever. To some extent the late Lord Rutherford shared this feeling by distrusting those who wanted to build up science on purely deductive lines. He was fully convinced that the line of advance followed by him so successfully, based on the application of sound common-sense considerations to experimental observation of the right phenomena, is the most trustworthy road to progress. This deep conviction did not prevent him, however, from early recognizing the fundamental importance of ideas moving largely on deductive lines, put forward by a young man joining the Manchester Laboratory shortly after the introduction of the conception of the nuclear atom. The union of Rutherford's nuclear concept with Bohr's ideas proved to be an immensely fruitful one, the importance of which even far exceeded Rutherford's early expectations. When some time after the birth of the nuclear conception, I asked Rutherford, during conversation in his hospitable house, if the origin of the β-particles accompanying radioactive disintegration is to be traced to the nucleus or not, he answered that he did not know, and suggested approaching Bohr with this question, thus showing the great appreciation of Bohr's insight in atomic processes he already had in these days.

In later years, when Rutherford spoke of the old Manchester days, he repeatedly remarked that we did not then fully realize what great times we were witnessing. Those Manchester days were the greatest period of Rutherford's scientific genius. With increasing age and still further increasing fame, Rutherford's great and kindly interest in his former and present pupils, his deep and sympathetic understanding of the difficulties experienced by them and mankind in general, have grown in like measure. For those who had the privilege of knowing intimately the personality and achievements of Rutherford, his death removes one of the great attractions of life.

M. le Duc de Broglie

Paris

I FEEL it a great honour that I have met Lord Rutherford of Nelson so frequently and that, only a few years ago, I was called upon to write, in NATURE of May 7, 1932, an appreciation of the great services which he has rendered to science. Now that we have lost him, we can see more clearly the magnitude of the part he has played during the past forty years in creating, to a great extent, the physics of the atom and of the nucleus.

One could give striking examples of the way in which he concentrated on the fundamental implications of any hypothesis which he adopted, and followed their consequences to the point where he was able to show clearly the need for the introduction of new ideas.

He, and the physicists of his school, probed the atom with swiftly moving electrified particles, and interpreted their results by means of the equations of classical mechanics. They were thus able to show the existence and the smallness of a central, heavy, positively charged nucleus, in the neighbourhood of which the ordinary laws of electrostatics begin to break down and to reveal new phenomena.

Bohr showed how classical mechanics must be modified to give rise to the atomic model which bears the names of Lord Rutherford and himself, and has recently emphasized the fundamental difference between interactions inside and outside the nucleus. In the first case, spheres of action encroach upon each other to such an extent that a particle cannot make contact with this region without affecting simultaneously all the parts which compose it. On the other hand, outside the nucleus, considerations proper to a two-body problem are still applicable.

In a more general fashion, the extraordinarily brilliant way in which the Cambridge school, led by Lord Rutherford, made use of formal mechanical models of the atom led to such progress in the knowledge and description of phenomena that physicists changed their outlook after the manner of explorers who, on the far side of a mountain range, discover a new country. It then became clear that concrete images and quasi-classical theories had been pushed to the extreme limits of their usefulness and that, to make further progress, it would be necessary to introduce new ideas. Thus Rutherford's name is honoured equally by those physicists who regret the passing of the old mechanical theories of the atom and by those who prefer the more abstract ideas which have replaced them.

The great man of science whose ashes now rest in Westminster Abbey close to his illustrious predecessors was taken from us at a time when the tremendous advances in nuclear physics were giving to his work the fullness it deserved, and, in the future, they will testify to the vigour and fertility of his genius.

Prof. J. Stark

President of the Physikalisch-Technischen Reichanstalt, Berlin

I AM glad of the opportunity afforded by the Editor of NATURE to write a few words about the late Lord Rutherford. I have admired Rutherford for the last thirty years, as one of the greatest research workers in the field of physics. When, in 1902, his fundamental publications on the transmutation of radio-elements appeared, I was so charmed by the clearness and elegance of his experimental demonstration and by the importance of his discovery that I wrote him an enthusiastic letter to Montreal and congratulated him on his discovery. For this discovery, Rutherford received the Nobel Prize in Chemistry. But he afterwards made more discoveries, chiefly of a physical character, which merited the Nobel Prize in Physics. I have therefore proposed several times to the Nobel Committee for Physics that Lord Rutherford should be distinguished by the award of the Nobel Prize in Physics also.

It is unnecessary to speak of the importance of Rutherford's discoveries for the development of research in atomic structure, for they belong already to the generally known fundamentals of atomistic research and will always be valid. Rutherford's was the spirit of a great man of science, who, basing his conceptions on reality, tries to solve great problems by watching and carrying out suitable experiments and careful measurements, and is not influenced by dogmatic theories. If future generations choose Rutherford as a model, physics will not become numbed by learned knowledge and dogmatic formulæ, but will achieve results through practical experimentation.

Prof. Otto Hahn

Kaiser Wilhelm-Institut für Chemie, Berlin

AT the request of the Editor of NATURE I gladly write a few lines in memory of my never-to-be-forgotten professor, Lord Rutherford.

In the autumn of 1905, I went to work with Prof. Rutherford in the Macdonald Physics Building at Montreal, and this visit was primarily responsible for my decision to change over from organic chemistry to radioactivity.

In addition to other problems, Rutherford was at that time working on the magnetic and electric deflections of α-rays, which he had recognized as helium atoms. A large variety of transformation products was investigated in the course of time, and I was fortunate in being invited to take part in some of this work. We determined the magnetic and electrostatic deflections of the α-rays from radiothorium, a substance which, by a stroke of good fortune, I had discovered shortly before in Ramsay's laboratory. The apparatus was fitted up in a dark cellar. The Toepler pump functioned slowly and not always satisfactorily, and many photographs had to be taken, for there was a very real danger of radioactive contamination. Rutherford was not to be discouraged by initial failure, however, and he was able to establish conclusively that the α-rays from radiothorium and from its transformation products are also helium particles.

Nothing could deviate him from his infective enthusiasm for work, which was imparted to all the members of his institute. Of these, apart from my German friend Max Levin from Göttingen, I should mention in particular Dr. A. S. Eve, who was later appointed successor to Rutherford in the Macdonald Physics Building. I recall with gratitude the never failing fatherly friendship and readiness to help which Rutherford showed towards us two foreigners. Love of our professor and of our work formed a bond of union also with the other members of the research department, H. L. Bronson, R. K. McClung and R. W. Boyle ; it was the link in our happy family circle.

All gatherings, whether of a scientific or of a social nature, bore the mark of Rutherford's outstanding personality, although he was then barely thirty-four years old. There was a combined physical and chemical colloquium at Montreal, and it happened not infrequently that the beloved α-particles slyly found their way into the discussion which followed a lecture on one or another problem of organic chemistry. Quite unintentionally, but nevertheless to everyone's joy, the most topical problems of radioactivity had again suddenly become the focus of the conversation.

At the same time, Rutherford was so sincere and unassuming in his dealings with his students and with the everyday things of life, that we two Germans in particular were constantly filled with surprise and admiration. We had no doubt imagined that such a distinguished professor would be an unapproachable person, conscious of his dignity. Nothing could have been further from the truth. I still possess a small photograph which shows him clearing away the snow from the entrance to his house. In this house we were often evening guests, listening in rapt attention to the intimate piano-playing of Mrs. Rutherford or to the spirited narrative of the Professor.

Early in the year 1906, a photographer came to the Macdonald Physics Building to take a photograph of Rutherford working in his laboratory, for publication in the columns of NATURE with an article by Dr. A. S. Eve on the Macdonald Physics Building. Rutherford was at first reluctant, but later he granted the photographer permission to take a few flash-light photographs showing him seated at his α-ray apparatus. The photographs were duly taken, and they were also quite good. In the opinion of the photographer, however, the already famous professor was not dressed elegantly enough for the readers of NATURE. Not even cuffs were to be seen peeping from the sleeves of his coat! But the photographer found a way out; I was to lend Rutherford my loose cuffs. They were so arranged that they protruded well beyond the ends of his sleeves. The photographer expressed satisfaction with the new photograph. As a result, in one of the volumes of NATURE for the year 1906 (NATURE, 74, 273), we see not only Prof. Rutherford seated alongside the apparatus with which he carried out his epoch-making experiments on the α-rays, but also one of the cuffs of a young research student, who treasures his sojourn with one of the greatest masters of physical research as one of the most beautiful memories of his life.

Prof. E. Fermi

University of Rome

THE unexpected news of Lord Rutherford's death reached me at Bologna, when I was taking part in a meeting for the bicentennial celebration of Galvani's birth. A large group of physicists from all nations were assembled there, and it was quite apparent how deeply everybody felt the loss that science had suffered, by the passing away of a man whose efforts had opened up to physics one of the widest and as yet unfathomable fields of investigation.

Lord Rutherford certainly belonged to that highest class of experimenters—very few in the history of human thought—who appear to their admirers to be led by some sort of instinct always towards the successful attack of fundamental problems. If we consider most of his experiments, we are impressed by the fact that they are conceived so simply as to be easily understood and appreciated by a layman; their performance does not require a complicated piece of machinery, nor even often exceptional experimental skill. But it is not exaggeration to state that such simple experiments, as for example the discovery of the positive nucleus inside its cloud of electrons, or the method for producing artificial disintegrations by α-particle bombardment, are milestones in our knowledge of Nature.

Lord Rutherford will be remembered in the history of science not only on account of his personal contributions but also as a teacher, in the highest meaning of this word. One of the largest and most successful groups of investigators developed around him and learned from him not only the principles and the methods of research, but also the necessity of endurance and steadiness as essential requirements of the man of science.

Prof. L. Wertenstein

Free University of Poland, Warsaw

I THINK that the concluding remark of Prof. Chadwick's tribute to the memory of Lord Rutherford in NATURE of October 30, p. 751: "we lost . . . our leader" can be applied not only to his immediate collaborators but also to whose who like myself, have worked on radioactivity and have followed for years the progress of his work

Although in the science of radioactivity most was done by Rutherford and his school, he is also responsible for a great part of what has been done elsewhere, because he opened up new fields of research and stimulated enthusiasm to such a high degree that it was impossible not to try to attain something approaching his splendid achievements. Every branch of physics has had leading men at different epochs, but we workers in radioactivity have been exceptionally fortunate in having such a leader.

I remember, when a young student in Mme. Curie's laboratory, the impression created by the appearance of every new paper of Rutherford's in the *Philosophical Magazine*. I would say, and many of my colleagues will believe me, these papers were considerable events in my life. A young scientific worker aims at perfection and looks for some ideal to follow: this perfection, this ideal, was to be found in Rutherford's way of showing simplicity in what seemed intricate, of attaining with apparent ease what was thought unattainable, of putting aside every obstacle as if it were merely a shadow. The uprolling of the magnificent film: "the α-particle", with the thin-walled tube and electrical counting, the crystal analysis of the γ-rays, it was more than science; it was an immediate contact with Nature, as if radioactivity itself chose him to unravel its secrets. We followed and admired him, but he took at times steps too large for us ordinary mortals, and when the paper on the nuclear atom appeared most of us could not believe it. I remember it gave me many sleepless nights, and I envy Chadwick for having listened to its first announcement; was it not the greatest day in the history of modern physics?

To have Rutherford's approval of one's work was a high reward for any worker in the domain of radioactivity. When Danysz focused the magnetic spectrum of β-rays, when Rosenblum discovered the fine structure of α-rays, what an immense joy it was for them to receive Rutherford's letters of congratulation. If such was the effect of his written word, no wonder so many wished to get nearer to him.

Although I occasionally saw Rutherford before the Great War, it was in 1925 that I had the opportunity of knowing him better and of working for some time in the Cavendish Laboratory. I chose for myself a small area in the enormous territory he has won for science; I was interested at that time in the physical properties of radon, one of those emanations the nature of which as chemical elements was established by Rutherford. I was happy enough to add some minor points to this problem, but if I mention it, it is simply because this work enabled me to live in the atmosphere of the great man. It was rather outside the main line of research pursued in the Cavendish Laboratory, but I am sure Rutherford did not disapprove anyone taking up one of the favourite themes of his earlier period, and when he spoke about it, it was as if he recalled a great adventure of his life. I learned to know his attitude in science. A man of science is often a dignified, perhaps a melancholy person: seeing him one would say: "science is a difficult thing". It was not so with Rutherford: he made you feel that science is, first of all, beauty and happiness. One would quote Goethe's words, "Ihr Anblick gibt den Engeln Stärke". This strength poured from his deep voice vibrating with the joy of creation, and even his laughter, which was so often heard during discussions of the utmost importance, was deeply rooted in the sources of this happiness. He liked others to be happy too and when he knew a physicist —of any nationality—was a 'good man', he was ready to help him if necessary. The atmosphere was contagious with genius, and during my stay in Cambridge I realized what a wonderful 'climate' it was for the highly gifted men who formed Rutherford's surroundings. Only a few names can be found ranking with Rutherford, but even more unique was the association of a great man of science with collaborators like Chadwick, Blackett, Ellis, Cockcroft and many others.

Rutherford has left us, but he survives in the hearts of all students of radioactivity and nuclear physics throughout the world. We mourn him, but our eyes are turned on those who are most deeply affected. While assuring them of our sympathy, we feel that the great inheritance is in good hands.

Dr. P. Kapitza, F.R.S.

Institute for Physical Problems, Moscow

The death of Lord Rutherford is unanimously deplored by all men of science, but especially is it felt by his numerous pupils.

Rutherford's pioneering work, which started forty years ago, has now developed into what we call the science of nuclear physics, and of this science we can call him the creator, since most of the new ideas and discoveries in nuclear physics have been due to Rutherford or to his pupils.

In the history of science, it is difficult to find another case when an individual scientist has had such great influence on the development of science. I think this was mainly possible because Rutherford was not only a great research scientist gifted with exceptional ingenuity, enthusiasm and energy essential for pioneering work, but because he was also a great personality and teacher. His ideas and personality attracted young research students, and his abilities as a teacher helped him to let each of his pupils develop his own character.

His way of dealing with his pupils, whom he called his "boys", was most instructive ; when a new research man came to him, Rutherford would first look for any originality and personality in the young man's work. Rutherford would always prefer the man to work on his own ideas rather than to have just another assistant working under his guidance. As soon as Rutherford discovered any sort of originality in his pupil, he would do everything possible to develop it to the utmost ; he would encourage him in difficult moments and moments of depression, would not be exigent in case of mistakes, but on the other hand would 'put on the brakes' when the young man became too optimistic, drawing premature conclusions from an experiment not thoroughly completed. The pupil of Rutherford would very soon learn that the judgment of his professor was always very reliable and invariably to the point ; especially good was Rutherford in judging what ought to be done. Once he told me how Moseley went to him, before starting a new problem, and suggested three subjects ; Rutherford advised him to choose the work which led Moseley to his famous results on the relations between the wave-length of X-rays emitted by elements and their atomic numbers.

Fairness in acknowledging the originality of the work and ideas of his pupils kept a very healthy spirit in the laboratory, his personal kindness and good will to his pupils gaining the greatest affection that a pupil can have to his teacher. I worked in Rutherford's laboratory for fourteen years, first closely under his direction and later independently, on magnetism, which was rather outside the scope of his line of work, but he continuously took interest in my doings, and to his interest, encouragement and friendship I owe a great deal in the accomplishments of my research.

Rutherford was fond of his pupils, and to have young research people was indispensable for him, not only because it gave better possibilities of working out a larger number of problems, but also because, as he often used to say, the young students kept him young. This was indeed quite true, for he kept not only young, but if I may say so, even 'boyish', to the end of his days. His enthusiasm, energy and gaiety never changed during the years I knew him, and he himself used to say that in research he always felt a young man ; he had the same ambition and the same curiosity all through life, and always felt in attacking a new problem that he stood on the same footing as his research men. The young research people helped Rutherford not to age also in another respect, for with his pupils he had to keep up to date in his ideas. He was never in opposition to the new theories, which a large number of physicists of his age would never recognize or else ignore, and I never heard him speak about the "good old age" in physics, when the fundamental laws of Nature were clear and no uncertainty existed.

I cannot think of any country from which young research people did not come at some time to work in his laboratory, in Montreal, Manchester or Cambridge. During my own time in Cambridge, I can remember students working in the Cavendish not only from Great Britain and the Dominions, but also from the United States, Chile, China, Czechoslovakia, Denmark, France, Holland, Germany, India, Italy, Japan, Norway, Poland, the Soviet Union, Switzerland and other countries. Most of them now occupy professorial chairs, and some of them have gained an international reputation in science. I am certain that in all these countries there will be men of science who will sincerely mourn Rutherford's death not only as the greatest research physicist since Faraday, but also even more deeply as their teacher and friend.

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interior of western Asia. Brak has also afforded from its early levels objects belonging to a Sumerian civilization of the Archaic period, revealed in this area for the first time. Among other accessions are the now famous inscriptions on potsherds from Lachish, which are deposited by the Wellcome Trustees. These inscriptions, the Lachish letters, are the earliest known example of written Hebrew, and refer to events mentioned in the Bible and relate apparently to the siege of Lachish by Nebuchadnezzar. The Egypt Exploration Society, at the instance of Dr. Alan H. Gardiner, has presented to the Museum the antiquities allotted to it from the Society's excavations on the site of Sesebi in the Egyptian Sudan, which were exhibited at the Society's rooms in July last. It will be remembered that these excavations are of special importance for the light they throw on the earlier years of Akhnaton's rule.

Introduction of Plants into British Colonies

THE Colonial Office has performed a useful service to growers and exporters of plants and also to the British Colonies, by the issue of a digest of the legislation on plant introduction in force at the end of December 1936 (London : H.M. Stationery Office, 1937 ; 1*s*. net). Introduced pests and diseases have occasionally done much damage : instances cited are 'brown hardback' (*Phytalus Smithi*), causing serious losses to the sugar planters in Mauritius; the 'wither tip' disease, largely responsible for the ruin of the lime industry in Dominica ; and the 'witchbroom' disease of cacao, now causing so much havoc in Trinidad. Since then, in 1876, Malta first instituted an ordinance "to prevent the introduction of diseases affecting agricultural produce", enactments have grown in number and diversity, and there is now real need for their comprehensive survey, such as is rendered possible by this publication, with the view of gradually simplifying procedure and introducing where possible more legislative uniformity.

To this end the third Imperial Mycological Conference, held in London in 1934, urged the adoption of a uniform type of health certificate throughout the Empire ; and a standard form accepted by all Colonial Governments appears in the appendix to this summary. Furthermore, the geographical grouping of some Dependencies permits a measure of common action in these matters which has great practical advantages, and the colonies of West Africa have entered into a plant exchange convention under which each Dependency enacts similar legislation. A similar convention now links the Union of South Africa, Southern Rhodesia and the Belgian Congo, to which Northern Rhodesia and Nyasaland have since become parties. Proposals have also recently been approved for a similar arrangement in respect of East African Dependencies, and the necessary legislation is under consideration. This useful summary may supply the basis upon which further common action may be based that may lighten restrictions upon trade without removing the necessary check upon the control of distribution of disease.

Manchester Scientists' Peace Association

THE Manchester Scientists' Peace Association, which has recently been formed with the objects of co-ordinating the influence and efforts of men of science of the Manchester district in the cause of peace, and of promoting a scientific and objective attitude to peace problems, held its first public meeting in the Milton Hall, Manchester, on December 13. The meeting was addressed by Prof. H. Levy, who stressed the importance of applying scientific methods to problems involving social relationships. He asked his audience not to be frightened by the feeling that the interaction of science and society is a political issue ; politics it may be, but it is none the less amenable to attack as an objective problem. The professional politician, educated as a rule in the classical tradition, is frequently unable to appreciate this, and the entry into politics of more men of scientific training is most urgently required. But whether actively engaged in politics or not, the scientific man, especially if he has brought children into the world, cannot evade the responsibility of ensuring to the best of his abilities that the powers of science are used for the benefit, and not for the destruction, of the coming generation. A general meeting of the M.S.P.A. is to be held on January 17, at which a constitution will be proposed, officers elected and a programme of activities discussed. Particulars can be obtained from the provisional honorary secretary, Mr. D. C. Henry, The University, Manchester.

Impacts of Science

IN his Streatfield Memorial Lecture on October 15, entitled "Chemical Changes and Chances", Sir Martin Forster described some of his early experiences and the development of science in his early years which not only give a vivid and happy picture of Streatfield's personality but also afford a highly suggestive glimpse of the reactions of discoveries and personalities in the same period. He recalls being assured in November 1892 that all the most important discoveries in organic chemistry had been made, and then refers briefly to the way in which Nef, Claisen, Fischer, Pope and others rapidly enlarged our ideas of valency, intramolecular change, the configuration of sugars, the Walden inversion, etc. In discussing the reactions of science on industry, Sir Martin stresses the factor of the reaction of personality to background, and the rarity of finding a brain in which chemical and commercial instincts are co-equally powerful. He endorses Mr. Cronshaw's conclusion regarding the languishing of the dyestuffs industry in Great Britain and repudiates the unjustified condemnation of the business man in which chemists sometimes too readily indulge. On the contrary, he asserts that, in his experience, business men take reasonable trouble to ascertain the facts with which they have to deal, and he cites examples of benefits which the world enjoys through their enterprise.

In the latter part of his lecture, Sir Martin discusses a number of problems arising out of the impact of science, and makes many shrewd comments on the attitude of chemists in such matters, which should stimulate a more rational attitude and wider scientific outlook in determining the conduct of the scientific worker as a citizen. In particular, he refers to the need for a practical attitude to the question of national defence if our liberty of thought and action is not to be lost, and of the need for more practical solicitude, enlightened by wider scientific outlook with increasing inter-communal tolerance and courage, to face ugly facts if the problem of productivity and distribution is to be solved. Equality of opportunity cannot be completed without equality of reception, which the human divergences render chimerical. The development of a community is the algebraic sum of self-development by its component members, although noteworthy material and ethical advance follow mainly from the deeds and ideals of its ablest members. The pursuit of science still does not liberate us from common human failings, and Sir Martin considers that one of our most serious problems is to prevent greatly increased comfort and opportunity for amusement from robbing our young people of self-reliance and ambition. On the solution of this problem the progress and happiness of our race will depend.

The Roads of France

In a paper on "Transport in France" presented by F. J. Wymer to the Institute of Transport on October 19, it is said that the image which generally lingers longest in the mind of an Englishman who has motored through France is a section of 'route nationale' stretching ahead of his car into the far distance, with poplar trees passing the eye on each side like the pales of a fence. The same type of road was to be found 1,700 years ago in Great Britain from Dover to London and York, from Southampton to London and Chester, and many other roads, as the system in France is, like our own, undoubtedly descended from that of the Roman Empire. In contrasting the present roads in Great Britain with those in France, it has to be remembered that no hostile force of any appreciable dimensions has landed upon the shores of Britain for nearly a thousand years; our defences have been upon the sea and so the roads were built with this end in view. Hence the roadways of England tended mainly to be local links from village to village and so in a meandering way passed through a maximum number of towns and villages. In France they were designed on a plan connecting by the most direct routes the capital with the military centres. Having such different road systems, it is interesting to note that both France and England seem to be following similar tendencies in developing their systems unlike other great European countries. In France, after the Great War it was decided, instead of concentrating upon a few selected routes, to improve the standard of the whole system just as is being done in Great Britain. In France, the roads are being modernized by widening, by the elimination of level crossings, by the re-designing of road junctions and the provision of modern surfacing.

The construction and upkeep of the French roads depends upon their status. The 'routes nationales' are maintained by the State and the 'routes départementales' by the departments. The smaller roads known as 'chemins vicinaux de grandes communications et d'intérêt commun' are looked after by the communes, but sometimes the departments give them financial assistance. The 'chemins vicinaux ordinaires' and the 'voies urbaines' are kept up by the communes and municipalities alone. Taking 125 francs to the pound sterling, the total sum expended annually on the construction and upkeep of the road system is nearly eight million pounds, or about one seventh of the amount expended upon the roads of Great Britain. As a whole the roads of France are on a lower standard than those of Great Britain, and it is difficult to draw a direct comparison between expenditure in different countries as 'values' and 'exchanges' are always altering. Taxes are imposed on road vehicles, and also on their fuels. The total sums collected by the French treasury from this source amount to nearly four times the annual expenditure on the roads.

Golden Gate Fair

The completion of 'Treasure Island' in San Francisco Bay has added about 400 acres of new territory to the United States. This man-made island will be the site of the 1939 Golden Gate International Exposition. It was formally delivered to the Government by the U.S. Army Corps of Engineers, who made the reclamation on November 21. The site of the Fair is an outstanding engineering achievement. It is happily situated between the world's two largest bridges. A special feature of the Exposition will be British Empire Day, which will be celebrated on May 27, 1939. A committee headed by Mr. A. G. Charlton, the British Consul General, is making plans for the occasion. In spite of the fact that the last of the filling material within the 17,760 ft. seawall has only recently been placed in position, two million pounds' worth of building construction work is already in progress. Large concrete and steel hangars have been completed. This Pageant of the Pacific will celebrate not only the completion of the San Francisco–Oakland and Golden Gate Bridges but also the latest developments of science and engineering skill. These will include the Halls of the Mineral Empire and of Science, the Palaces of Business Progress, including electricity and communications, and pavilions devoted to Agriculture and Homes and Gardens. A new type of architectural design which is called 'Pacific' will combine Eastern and Western styles in a harmonious way. To beautify the grounds, £300,000 will be spent on landscape gardening and horticulture. The western States jointly with California will be hosts at this Pageant of the Pacific. British Columbia has announced that she will participate. Fifteen foreign nations have already stated their intention to take part in the Exposition. A view of the 400-acre island reclaimed from the sea in San Francisco Bay is shown in the *Electrician* of December 10.

Meteorology in the Navy

THE Admiralty has announced the re-institution of a Naval Meteorological Branch of the Hydrographic Department, a branch which was created during the Great War but was merged with the Meteorological Office in 1920 when the latter institution was taken over by the Air Ministry, and then became the Naval Division of the Meteorological Office. Capt. L. G. Garbett, who has been its superintendent, is to be the chief superintendent of the reconstituted Naval Meteorological Branch of the Hydrographic Department, under the Hydrographer of the Navy, and will be assisted by three naval officers and a civilian staff. Although the change is being made only for administrative convenience, and does not coincide with any drastic change in naval meteorological practice, the applications of meteorology to naval operations have steadily increased in recent years, especially that part of meteorology concerned with the wind structure and the physical state of the upper atmosphere, which are of such importance for flying operations. For this reason, the existence of an efficient meteorological service organized especially in accordance with naval requirements has become a matter of even greater importance than formerly. The Meteorological Office, under the Air Ministry, has also greatly extended the scope of its activities, and will remain the principal seat of meteorological learning and research.

Palestine Journal of Botany and Horticultural Science

IN 1935–36 three numbers appeared of a new journal with this title, under the editorship of Dr. H. R. Oppenheimer; the journal is published at irregular intervals; each volume contains 10–15 sheets, of 16 pages each, and is sold abroad at the rate of one shilling per sheet. Papers published deal mainly with the plants and plant problems of Palestine or with experimental work in plant physiology or horticulture. From its descriptive nature, botanical work in a new country needs a local publication medium to record observations which are, in the main, of interest to the inhabitants of the new country, though they also attract the attention—of systematists especially—of all countries. It is to be hoped that this new venture, which includes brief Hebrew summaries of the main items in the last number of the volume, may find enough supporters in Palestine and amongst those interested in systematic botany and horticulture to enable it to continue. It is announced that Dr. Israel Reichert, mycologist and plant pathologist, joins the editorial board from the publication of the second volume; this suggests that plant pathology will be more strongly represented in future numbers. The third number contains an editorial appreciation and photograph of G. Mosheyoff, assistant in plant physiology at the Hebrew University, who died at the age of twenty-three years as the result of wounds received during the recent disturbances at the defence of the colony Koryath Anavim. The agent for the journal in Europe is W. Junk, The Hague.

Gift to University of Melbourne Medical School

THE University of Melbourne has received from the trustees of a large estate in Australia the sum of £50,000, to be held in trust and the income applied to the Medical School, and especially to raise the status of the pre-clinical chairs. The salary attached to the chairs of anatomy, physiology, pathology and bacteriology, hitherto £1,200 (Australian) a year, is to be raised to £1,700 a year, in addition to which the University pays 2½ per cent to a superannuation fund. It is hoped by this means to strengthen the scientific portion of pre-clinical education, particularly in the second and third years, thus improving the fundamental basis for the following three years of the present six-year course.

A New Species of *Sempervivum*

DR. W. B. TURRILL describes a new species of *Sempervivum* in the *Gardeners' Chronicle* of October 23. It is *S. octopodes* Turrill, and was discovered on Mt. Peristeri in north Macedonia, by Dr. R. Seligman, during an expedition with Dr. Giuseppi. A full Latin diagnosis appears in the paper, and it is encouraging to note that the variety *apetalum* promises to become a good plant for the garden. Both type and variety have been cultivated by Dr. R. S. Wale, but the variety is much more amenable to horticultural treatment than the typical species.

Official Statistics

THE Guide to Current Official Statistics of the United Kingdom for 1936 (London: H.M. Stationery Office. 1*s.*) has been published. It is compiled on the lines which have now become familiar. The main part of the volume is an alphabetical list of subjects with reference to the official volumes available. Secondly, there is a numerical list of publications arranged under the headings of various departments. The volume reveals the wide range of subjects upon which official statistical information is available.

Thomas-Gilchrist Basic Process

A PAPER by F. W. Harbord at the autumn meeting of the Iron and Steel Institute gives an account of the history of the Thomas-Gilchrist basic process from 1879 to the present date, from the preliminary experiments in a six-pound converter to the present-day production of ninety million tons of basic steel per year. As a contribution to the history of modern steel-making this paper is of real value.

Announcements

THE King has been pleased to appoint the following members of the medical profession engaged in public health work, both in central and local government, as honorary physicians: Sir Arthur MacNalty, chief medical officer, Ministry of Health and Board of

Education; Sir Edward Mellanby, secretary of the Medical Research Council, formerly professor of physiology in the University of London; Mr. J. H. Hebb, director-general of medical services, Ministry of Pensions; Mr. J. C. Bridge, senior medical inspector of factories, Home Office; Sir Frederick Menzies, medical officer of health and school medical officer to the London County Council; Mr. A. S. N. MacGregor, medical officer of health for Glasgow.

DR. M. C. G. Israels, assistant director of the Department of Clinical Investigation and Research in the Manchester Royal Infirmary, has been appointed by the Council of the Royal Society to a Foulerton Research Fellowship. The appointment will date from January 1, 1938; and Dr. Israels proposes to carry out research on the nature and ætiology of leukæmias and allied conditions.

PROF. A. S. SPILHAUS has recently been elected a foreign member of the Royal Meteorological Society. Prof. Spilhaus is assistant professor of meteorology in New York University, and previous to this he was connected with the South African Weather Service. He has published a number of short papers which have appeared in the *Bulletin of the American Meteorological Society* during the last two or three years, all of them showing marked originality, particularly in designing meteorological apparatus.

AT the Coronation Inventions Exhibition held at Sheffield and Leeds, the double award of the Founder's Silver Medal and the Institute of Patentees' Silver Medal has been made to Dr. S. C. Blacktin for his electrotor dust and smoke meter (see NATURE, 140, 982, Dec. 4, 1937).

MR. E. GRAHAM CLARK has been appointed secretary to the Institution of Civil Engineers in succession to the late Dr. H. H. Jeffcott.

DR. F. HEATHCOAT, lecturer in chemistry and fuel technology at the College of Technology, Rotherham, has been appointed to the post of vice-principal and head of the Chemistry Department at the Technical College, Swansea.

MR. J. C. TREVOR will read a paper entitled "Some Anthropological Considerations of Race Crossing" before the Eugenics Society in the rooms of the Royal Society, Burlington House, London, W.1, on December 21 at 5.30. The meeting is open to the public.

A SPECIAL exhibition, illustrating the "Childhood of Animals", which will be open from December 20 until March 31, is being arranged by the Department of Zoology at the Horniman Museum, Forest Hill, S.E. The exhibition will comprise such objects as a baby koala, clinging to its mother's back; the adults, young, nests and eggs of various typical or striking species of birds; the life-history of a butterfly; and models of larvæ of the frog and a marine worm. It is thought that Christmas, which so peculiarly belongs to the children, would be an appropriate time for the opening of such an exhibition.

THE annual Conference of the Geographical Association will be held in the London School of Economics on January 4–6, under the presidency of Prof. Patrick Abercrombie. Prof. Abercrombie will deliver his presidential address entitled "Geography, the Basis of Planning" on January 4. Further information can be obtained from the Geographical Association, c/o Municipal High School of Commerce, Princess Street, Manchester, 1.

THE twenty-fifth election of Beit fellows for scientific research will take place on or about July 8, 1938. Each fellowship is of an annual value of £240 and is tenable for two years. Fellows will be attached to a department of the Imperial College of Science and Technology. Not more than three fellowships will be awarded. Further information can be obtained from the Rector, Imperial College, South Kensington, London, S.W.7.

UNDER the terms of administration of the Clough Memorial Research Fund administered by the Edinburgh Geological Society, a sum of approximately £30 is available annually for geological research in Scotland and the counties of Northumberland, Cumberland, Durham, Westmorland and Yorkshire. Applications for grants are invited for the period April 1, 1938–March 31, 1939. Further information can be obtained from the Secretary, Clough Research Fund Committee, Edinburgh Geological Society, Synod Hall, Castle Terrace, Edinburgh.

THE following appointments and promotions have recently been made in the Colonial Service: A. P. S. Forbes, agricultural officer, Nyasaland; G. M. Gates, veterinary officer, Nigeria; G. R. Groves, horticulturist, Bermuda; F. M. Levin, meteorological assistant, British West Africa Meteorological Service, Gold Coast; W. B. Mason, inspector of plants and produce, Gold Coast; L. S. Matthews, meteorological assistant, British West Africa Meteorological Service, Nigeria; J. D. F. C. McDonald (senior plant pathologist, Kenya), director of agriculture, Cyprus; S. J. Saint (assistant director of agriculture and chemist), director of agriculture, Barbados; F. Flippance (assistant curator, Gardens Department, Straits Settlements), superintendent, Botanical and Forestry Department, Hong Kong.

ANNOUNCEMENT is made of the forthcoming publication of an "Annual Review of Physiology", in which it is proposed to review the developments of the preceding year or biennium in the major fields of physiological research. The series will appear under the auspices of the American Physiological Society, Inc., and the Annual Review of Biochemistry, Ltd. The new review will conform in general style and format to the "Annual Review of Biochemistry". Prof. J. Murray Luck, Stanford University, California, will serve as managing editor.

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. 1066.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Origin of Yolk Lecithin

WE administered labelled (radioactive) sodium phosphate to a hen by subcutaneous injection and, after the lapse of 28 hours, removed 34 yolks from the ovary having an aggregate weight of 30·6 gm. The lecithin of each yolk was then extracted and the phosphorus content and radioactivity determined. The blood plasma, blood corpuscles and the liver were treated in a similar way. The results obtained are seen from the accompanying table, in which for sake of simplicity the specific activity (activity per mgm. P) of the blood plasma phosphatide phosphorus was taken to be 1.

SPECIFIC ACTIVITY (relative activity per mgm. P).

Extracted from	Phosphatide P	Non-phosphatide P
Plasma	1	0·83
Corpuscles	0·37	0·28
Liver (alcohol + ether extract)	1·24	1·18
Liver (ether extract)	1·22	—
Yolk, 30–100 mgm. (average)	0·044	1·44
Yolk, 690 mgm.	0·65	1·38
Yolk, 2,510 mgm.	1·18	1·48
Yolk, 4,500 mgm.	0·7	—

Before interpreting the figures obtained, we wish to recall the following facts. We found that while labelled phosphorus in sodium phosphate exchanges rapidly with the phosphorus in bone phosphate, it does not exchange with lecithin phosphate[1]. Furthermore, when the labelled P is first put into the blood, 1 mgm. P will show, for example, 10,000 activity units ; as a result of a rapid exchange going on chiefly between bone phosphate and the inorganic phosphate of the blood, 1 mgm. will soon correspond to less than 10,000 activity units ; in the case of the hen, we found the above-mentioned activity to amount after the lapse of 28 hours only to about 10.

When doing research with labelled P we are mostly, as in the present case, interested in the quantitative determination of the amount of a phosphorus compound synthesized in the body after the administration of the labelled P. The above-mentioned rapid change in the sensibility of our indicator with time makes it, however, very difficult to obtain the result desired ; a high activity of the phosphorus compound in question being quite compatible with the new formation of only a small part of the compound in question and vice versa. In the experiments discussed in this note, there can, however, be little doubt that the phosphatide molecules present in the liver of the hen were to a very large extent formed within 28 hours, that is, after the administration of the labelled P.

In experiments which we were able to carry out through the kindness of Prof. Lundsgaard and Dr. Blixenkrone on isolated livers of cats and in which no skeleton or other organs were present, the difficulties mentioned above do not occur. In these experiments we found that within 2·5 hours of perfusion, about 1 per cent of the liver phosphatide gets labelled and is thus newly formed. In the living organism, the liver metabolism is certainly not less effective than in an isolated liver, and therefore there can be scarcely any doubt that within 28 hours a great part of the phosphatide molecules present in the liver was newly formed.

As the specific activity of the blood plasma and also of the yolk lecithin do not differ greatly from that of the liver lecithin, we have to conclude that the lecithin molecules present in the blood are also to a large extent newly formed within the last 28 hours. That the difference between the specific activity of the phosphatide P of the liver and yolk, as is seen in the table above, is smallest in the case of the 2,500 mgm. yolk is just what we should expect. Such a yolk is to a large extent formed[2] within 28 hours, while that is to a less extent the case both for smaller and larger yolks. We thus conclude that the yolk lecithin was taken up from the plasma, the plasma lecithin being replaced by molecules formed at least mainly in the liver. In the case of the hen experimented on, within 28 hours about 40 mgm. yolk lecithin P was formed, the phosphatide P present in the total plasma was 20 mgm., and that in the liver 38 mgm. The large drain on the liver P necessitated the formation of a large part of the liver phosphatide, which was synthesized from labelled blood and thus became active.

It is of interest to note that the blood corpuscle lecithin P only shows one third of the specific activity of that of the plasma lecithin P. This finally disposes of the theory according to which the place of formation of the blood lecithin is the blood corpuscles. We also carried out *in vitro* experiments in which blood was shaken for some hours with labelled sodium phosphate, and determined the amount of labelled phosphatide formed ; it amounted only to 1/1,000–1/2,000 of the total phosphatide present in the blood.

Mr. A. H. W. Aten extracted the phosphatides from the organs of a hen only 5 hours after administration of the radioactive sodium phosphate. Taking the specific activity of the plasma inorganic P to be unity, the following values were obtained for the specific activity of the phosphatide P : liver 0·54, plasma 0·44, ovary 0·039, yolk, maximum 0·034, and intestine 0·11. The above figures show clearly that the liver of the laying hen is responsible for the formation of most of the phosphatides, which are then carried by the plasma into the ovary.

In an egg removed from the oviduct the yolk phosphorus was found to be scarcely active ; from this we must conclude that this yolk had not grown within the previous 28 hours. The shell P of this egg showed the specific activity of the inorganic plasma P.

Some of the labelled phosphorus used in our experiments was prepared by us from sulphur under the action of neutrons emitted by a radium-beryllium mixture most kindly put at our disposal by Prof. Niels Bohr, and some of it was a generous gift from Prof. Lawrence of the University of California. We should also like to express our best thanks to Miss Hilde Levi for her assistance in this work.

L. HAHN.
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Oct. 28.

[1] Skandin, *Arch. Physiol.*, **77**, 148 (1937). The work of Artom and his colleagues (NATURE, **139**, 836 (1937); *Arch. internat. Physiol.*, **49**, 32, 37) is also based on the assumption that phosphatide P does not exchange.

[2] Comp. Gerhartz, H., *Arch. gesamt. Physiol.*, **156**, 215 (1914).

An Effect of Catastrophic Ionospheric Disturbances on Low-Frequency Radio Waves

RECENTLY there has been much interest in those catastrophic ionospheric disturbances which are supposed to produce 'radio fade-outs' on high-frequency radio waves and short-lived disturbances in the terrestrial magnetic records. In a recent report, Dellinger[1] has given an account of the results of these disturbances, based on more than a year's observations by workers in different parts of the world, and he states that "ordinarily the intensities of the waves received from radio stations on frequencies below about 1,500 kc./s. are not perceptibly affected during a fade-out". He mentions, however, that Bureau[2] has found an increase in the number of atmospherics on frequencies between 27 and 40 kc./s. during many of the disturbances; this is the only evidence so far published that the propagation of low-frequency waves is affected at these times.

We have been engaged, for some years, in studying the phase of the downcoming wave received at Cambridge from the low-frequency sender at Rugby (frequency 16 kc./s., distance 90 km.) by a method which has been described elsewhere[3]. The variation of phase of the abnormal component (that is, the component of the electric vector which is parallel to the ground) of the wave near sunset is usually observed to be of the form shown in Fig. 1. Other evidence leads us to suppose that the equivalent reflection height in the daytime is about 65 or 70 km., and that Fig. 1 represents an increase of this height by about 12 km. during sunset. On some occasions a very marked, but short-lived, disturbance in the ordinary behaviour has been noticed, an example of which is shown in Fig. 2.

On these occasions it appears that the normal sunset increase of reflection height is temporarily interrupted, and replaced by a decrease. It is of interest to investigate how far these phase anomalies at low frequencies are related to other phenomena which are supposed to be produced by catastrophic ionospheric disturbances. In an analysis of the results so far obtained, we have compared the times of occurrence of the low-frequency phase anomaly with the times of fade-outs, increases in atmospherics, and magnetic anomalies occurring on the same days. The times of fade-outs and increases of atmospherics have been taken from published data supplemented by data supplied by our colleagues in Cambridge.

The magnetic data have been taken from the published hourly mean values of the magnetic declination observed at Abinger. A curve drawn through th hourly mean values of the declination was compare with a similar curve drawn through the monthl mean values, and the times and magnitudes c

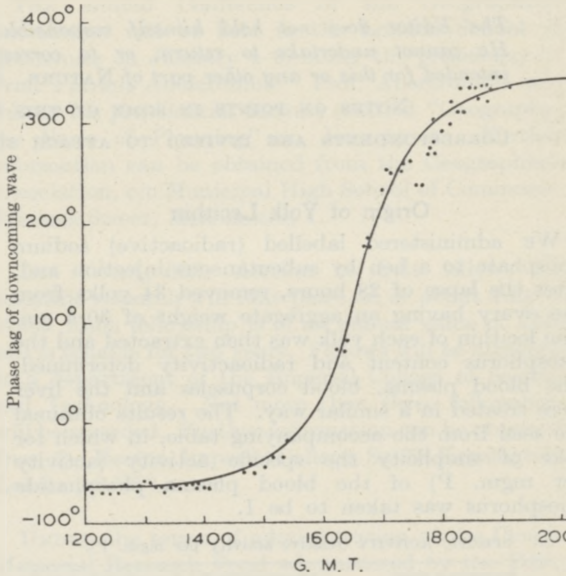

Fig. 1.
FEBRUARY 25, 1937.

magnetic anomalies were noted. A departure from t mean of more than two minutes was classed as anomaly, since departures of magnitudes greater th this were found to be infrequent on days which show no low-frequency anomaly.

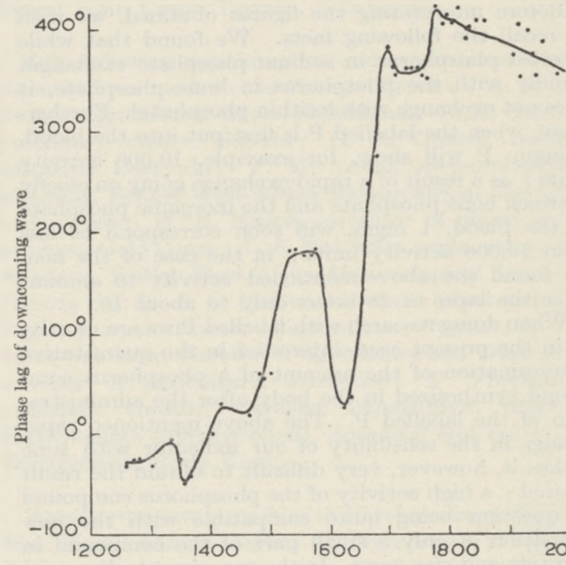

Fig. 2.
NOVEMBER 6, 1936.

Low-frequency phase anomalies were noticed eighteen days. Of these, seven coincided with ported fade-outs, to within about a quarter of hour. Whenever a fade-out was reported at a ti when detailed observations were being made on low frequency, an anomaly was observed. On three occasions the low-frequency anomaly coincided with a reported increase in atmospherics observed on a frequency of 27 kc./s. On the remaining eight days no fade-out or increase of atmospherics was reported, but the low-frequency phase anomaly was associated with a magnetic anomaly, occurring within one hour of the observation.

We conclude that a catastrophic ionospheric disturbance has a marked effect at the level of reflection of the low-frequency waves (70 km.), this effect being most evident as a decrease in reflection height of the waves.

Our experiments have not shown any clear indication of a change in reflected wave amplitude at the time of the phase anomalies. The change in received amplitude of atmospherics noticed by Bureau may be the result of a change in reflection height altering the phase relation between the interfering downcoming and ground waves, or it may be due to a real change in the amplitude of the downcoming wave, which occurs in his case but not in ours, either because the reflection is much more oblique, or because the frequency of his observations is different from that of ours.

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Nov. 9.

[1] Dellinger, *Bur. Stand. J. Research*, **19**, 111 (1937).
[2] Bureau, *Comptes rendus*, **203**, 1257 (1936).
[3] Best, Ratcliffe and Wilkes, *Proc. Roy. Soc.*, A, **156**, 614 (1937).

Effect of a Magnetic Field on the Electrodeless High-Frequency Discharge

THE following experiment, which originated from an investigation of the magnetron, seems to be of more general interest as it happens to confirm some recent theories (especially those of Prof. V. A. Bailey) on what happens to wireless waves in the upper atmosphere.

It is well known that the electrodeless high-frequency luminous discharge can be started by comparatively low voltages in a gas at very low pressures. It is only necessary to place the bulb of low-pressure gas between two plates connected across a tuned circuit coupled to a medium-power wireless generator. If the pressure is so low that the mean free path is long, any electrons present will vary in speed in unison with the voltage alternations, and if the maximum speed attained (which depends on the amplitude of this voltage) is sufficient to produce ionization by collision, a discharge may be started. It seemed likely that if instead of allowing the speed of the electrons to rise and fall they were continually accelerated a discharge would start with a much lower voltage. This can be done by applying a fixed magnetic field perpendicular to the electric force which causes the electrons to move round in orbits; the time of turning through 360° depending only on the magnetic field strength. If this strength is so adjusted that this time is equal to the periodic time of the high-frequency voltage, a sort of resonance occurs (if the free path is long enough) and the electrons move round faster and faster in orbits which get bigger and bigger. The condition for resonance is that the product of the wave-length in metres and the field in gauss should be approximately 110.

It is necessary, however, if the orbit in which ionizing speed is attained is not to be too large, so that the experiment can be conducted in a bulb of reasonable size, that a short wave be used. The following experiment was done with a 6 metre wave-length and a field of about 18 gauss. As the pressure of air in the bulb was reduced, it was found that down to pressures of about $\frac{1}{10}$ mm. of mercury, the potential required to start the discharge was unaffected by the magnetic field, but a further reduction in pressure and consequent increase in the mean free path had a most striking effect. At $\frac{1}{70}$ mm. the field reduced the starting potential by a factor of 5, at $\frac{1}{100}$ mm. by a factor of about 40, and at the lowest pressure which could be read on the gauge—something less than $\frac{1}{500}$ mm.—the discharge still started quite easily with the magnetic field on but it could not be started at all without it.

In the upper atmosphere, the magnetic field is less than 1 gauss and the wave-length for resonance is therefore much longer than the above, but there is no bulb to limit the orbit size. The electric force in a wireless wave is of course far too small to work the electrons up to ionizing speed before a collision, but the resonance results in the transfer of considerable energy from the wave to the medium, with the consequences explained by Prof. Bailey.

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Interpretation of Atomic Constitution

A WARY man hesitates to cross swords with a skilful fencer, but it is cowardly to decline to face difficulties. Colonel Moore-Brabazon might well have asked for other explanations—Why two electricities? What is the difference between the so-called positive and negative electricities? What is negative energy? Why does not the electron explode? However, he is probably prepared, like the rest of us, to accept Nature as we find it, and the paths that we follow are forced upon us rather than chosen.

It is permissible at least to emphasize the *protean* forms of energy which exist, for the transmutations of energy are quite remarkable. For example, work generates a proportionate quantity of heat (kinetic energy). The energy $w = Jh$, where h is in heat-units and J is Joule's constant; alter the units and state $W = H$, or energy equals heat generated.

Again, energy is proportional to mass ($w = mc^2$, where c is the velocity of light). Change the unit of mass, and energy equals mass, or $W = M$.

So, too, energy may leave an atom as a photon and $w = hf$, where f is the frequency of the wave and h is Planck's constant. With another change of units, it follows that $W = F$, or energy is frequency. Altogether it follows that energy = mass = heat = frequency!

The conservation of energy is the conservation of mass and is the conservation of frequency, and frequency may be as important as energy. But no one supposes that mass is merely a number—the first blow dispels that illusion.

Most remarkable is the fact that in certain circumstances a photon, in the shape of a high-frequency gamma ray, will *materialize* and give rise to an electron and a positron, so that 'light' becomes two masses, if you like, two charges, if you will, two waves, if you prefer it, but certainly two entities, very similar in character, mass, velocity, momentum, energy, and properties in a magnetic field except for swerving opposite ways and therefore having opposite charges, whatever that may mean.

There is no reason why a neutron may not have so much electrical energy within it that its mass may be electrical: But why lay down the law about things of which at present nothing is known? There is no *credo* in science, and no one knows what force, or mass, or energy are, but they have measurable properties. Measure them and keep the balance sheets!

Electrons are used in countless valves for telephony and wireless sets—but as for defining an electron—whose job is that? A thing is known only by its properties.

The mass of an electron increases with its velocity, particularly at speeds approaching the velocity of light. This was known in theory before it was verified by experiment in pre-relativity days. Does a neutron also increase in mass with velocity? This is a difficult point involving experiments that are far from easy. Two of my Cavendish friends answer yes, the neutron will increase in mass with speed, following relativity principles.

The nucleus of an atom is a small region compared with the atom itself. The nucleus seems to be composed of those things which come out of it, such as protons, neutrons, alpha particles. But these elements when *inside* the atom may have a very different character, and the interior may be a seething collection of electrical waves, having frequency, energy, mass, which may not need to be "held together". No one knows how an electron continues to exist or why it does not violently explode. Small-scale phenomena need not resemble large-scale happenings. It is remarkable to what extent many macroscopic results do hold good in the microcosm, but it is quite certain that quantum theory is needed to explain spectra, and that everyday mechanics will not suffice for the atom and its behaviour.

Five years ago, Bohr was writing: "As soon as we inquire more closely into the constitution of even the simplest nuclei, the present formulation of quantum mechanics fails essentially . . . but it is interesting to note that the energy liberated by the formation of the nucleus, as calculated from the so-called mass-defect by means of Einstein's relation ($w = mc^2$) is in approximate agreement with the binding energy of the protons to be expected on quantum mechanics from the known nuclear dimensions".

Physicists will move on from strength to strength, astonished at their great successes in forty years. Unfortunately, only those who spend an arduous life-time in theory and research are able to appreciate fully both their achievements and their failures.

If these views have any merit it belongs to others; if any errors they are my own.

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Physiological Patterns and Mental Disturbances

THAT a diminution in the oxygen tension of the inspired air can produce mental changes is an established fact. Far less certain is the possible correlation between psychotic manifestations as seen in clinical practice and an impoverished supply of oxygen to the central nervous system. It was thought that further light might be shed on this possibility by estimating the gaseous content of arterial blood and also of that drawn from the internal jugular vein of the same subject. In a group of patients in which the diagnosis of schizophrenia appears certain, this procedure has been carried out according to the method used by Lennox[1], and the following results were obtained:

Arterial Blood		Venous Blood		*A. V.* Δ		Blood	O_2 Cap.
CO_2	O_2	CO_2	O_2	CO_2	O_2	*R.Q.*	
(64)*	(64)	(59)	(59)	(58)	(53)	(58)	(50)
50·42	17·72	57·05	11·39	6·71	6·46	1·072	19·01
49·14†	18·12	54·96	11·96	5·82	6·2	0·95	19·56

*Figures in parentheses represent number of subjects. Arterial and venous blood was withdrawn from the same subjects but in five cases one failed to enter the internal jugular; this accounts for the larger number of arterial samples.

† Figures in this line reported by Lennox[1] in non-schizophrenic subjects.

A complete report of these findings, together with those from the control group, will appear at a later date, and at that time a brief clinical summary will be given of each patient studied, thus eliminating some of the vagueness which necessarily accompanies such an indefinite and general term as 'schizophrenia'. Suffice it to say at present, that the group was a representative one in that some of the patients were of the active and paranoid type whereas others were of the catatonic variety; some were actively engaged in manual labour and others were confined in a demented state to their respective wards.

As the blood samples were being withdrawn, a spirograph was recorded on the Roth-Benedict apparatus in order to detect any temporary alterations in breathing which might affect the gaseous content of the blood examined. The marked regularity in rhythm, uniformity in depth of both inspiration and expiration, and small tidal air in the schizophrenic group before, during and after the puncture was noted in contrast to the relative irregularity of all of these features before the puncture and a marked irregularity which supervened at the time of the puncture in the control group.

Segregating the pneumographs by inspection of the tracing, the following distribution is found:

	Number of subjects	% of cases showing 'regular type' of breathing	% of cases in which spirograph was neither regular nor irregular	% of cases showing 'irregular type' of breathing
Normal	30	6·6	17·4	76
Schizophrenic	57	77·7	7·5	14·8

The cardiac output, determined by Grollman's method, has also been measured in a few of the patients and in the control group. The difficulties inherent in the technique and also entailed in obtaining the necessary co-operation of the patient have limited the number of such observations so that, as yet, they are not sufficiently extensive to be entirely representative. However, the figures at hand demonstrate a small stroke volume and cardiac index in the majority of those schizophrenics on whom cardiac determinations have been made. The catatonic individuals have a smaller stroke volume and cardiac index than the paranoid. In agreement with others we have found the basal metabolic rate to be in general low.

All these observations have been repeated a number of times on some of the subjects from both groups. Extremely consistent findings are obtained from the schizophrenics, whereas those from the control group show a greater variability on separate occasions. It is generally more difficult to establish a strictly bas state in a mental patient than in a normal individual, and yet, in spite of this, there is more likelihood of finding the figures for blood gases, cardiac output and respiration more nearly the same in a schizophrenic than in a member of the control group. It would seem that the schizophrenic physiology is less susceptible to change. On one occasion when a schizophrenic individual was breathing into the Roth-Benedict apparatus, he began to hyperventilate both forcefully and rapidly, keeping this up for 3½ minutes before he could be persuaded to desist. Following the period of hyperpnœa, his respirations continued with exactly the same rhythm and uniform depth as before the onset of his voluntary hyperventilation; there was no period of apnœa and no semblance of Cheyne-Stokes' type of breathing. This set or fixed type of physiology is one which cannot readily adapt to the ever-changing internal and environmental demands; it is one which would allow greater fluctuations in the *milieu interieur*.

It would appear that there is no one single physiological characteristic found in schizophrenic patients which cannot also be found in the normal population. We have found members of the control group with a very regular type of respiration, others with a small tidal air, and still others with a small cardiac output; some with a high arterial carbon dioxide or a low oxygen saturation. Still others may have a low basal metabolic rate or else a large difference in the gaseous content of arterial and internal jugular blood, or else a low blood pressure. Fewer still show the fixity of physiological processes and none, so far as we have observed, presents the combination of these phenomena to such a degree as does the schizophrenic.

It would be extremely interesting to know whether this pattern of physiological responses be present before the onset of frank psychotic manifestations, and we are at present gathering material which will decide this point. On the basis of the results obtained in a limited number of instances, one would say that this type of physiological activity is more characteristic of the individual than of his illness, and therefore precedes its appearance.

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(Lackie-McTier Fellow,
University of Edinburgh).
WM. CORWIN.
J. H. ASTE-SALAZAR
(Peruvian Fellow,
Rockefeller Foundation).

Fatigue Laboratory,
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Boston, Mass.
Oct. 17.

[1] Lennox, *Arch. Neurol. and Psychiat.*, **26**, 719 (1931).

Alleged Specific Effects of High-Frequency Fields on Biological Substances

VARIOUS claims for the demonstration of specific electric actions of high-frequency fields on biological substrates, that is, non-thermal effects dependent on wave-length, have already been refuted[1]. Attenuation of some bacterial toxins exposed to 1·9–3·7 m. fields, under conditions which appeared to eliminate the influence of the heat developed, seemed nevertheless to indicate the existence of such an athermal action (Szymanowski and Hicks[2]). Subsequent negative results with different bacteria, etc., led these authors[3] to suspect that their previous results might have been due to an undetected local rise of temperature, although a selective heating of small dispersed particles (bacteria, micellæ, macromolecules) is improbable because of the rapid heat exchange with the medium[4].

In these circumstances it was deemed essential to check the positive observations of Szymanowski and Hicks by exposing solutions of bacterial toxins to high-frequency fields of considerable strength under conditions which would strictly limit the rise of temperature. (Szymanowski and Hicks usually allowed a rise of average temperature to about 30° C. Since one surface only of the liquid was cooled, a steep temperature gradient was probably set up across the toxin layer.) The necessary conditions can be defined with some exactitude, and they have been embodied in two experimental arrangements: (*a*) the 'static' one, in which a film of liquid is enclosed between cooled condenser plates 1 mm. apart, and (*b*) the 'dynamic' one, in which a column of liquid of diameter 4 mm. is passed through a condenser field (each element being exposed for 0·15 sec.) and cooled during its return to the field[5].

For the static method we can calculate the maximum rise of temperature in the centre of the film when the voltage across the plates and their temperature are kept constant[5]. With the tetanus toxin solution used in our experiments (conductivity $0{\cdot}8 \times 10^{-4}$ ohm^{-1} cm.$^{-1}$ at 3° C.) this maximum temperature would, in the absence of convection effects, exceed the plate temperature by 0·17° C. with a potential gradient of 1000 v./cm. and by 2·54° C. with 3000 v./cm. With some simplification, the rate of heating can also be computed for the dynamic method[5]: with conductivities of $0{\cdot}54 \times 10^{-4}$ ohm^{-1} cm.$^{-1}$ (0·1 per cent solution of tetanus toxin in distilled water) and $1{\cdot}63 \times 10^{-2}$ ohm^{-1} cm.$^{-1}$ (1 per cent sodium chloride solution) at 20° C. the maximum rise of temperature during one passage through the field of any element of the fluid should be 0·013° and 3·8° C., respectively, for 2500 v./cm. and a wave-length of 3 m.

The value calculated for 1 per cent sodium chloride solution was confirmed experimentally by recording the resistance changes in the exposed region with an A.C. bridge and oscillograph during motion of the fluid: the average rise of temperature was 2–3° C., with a maximum variation of 0·5° C. during the slow phase of the rhythmic movement of the pump. Since the initial temperature was below 3° C., the maximum temperature of the toxin solutions in either method is far below that at which the rate of destruction of the toxin would be significantly increased.

Movement of 16 cm.^{3} of 0·1 per cent tetanus toxin solution for 4·5 hours at 3° C. in absence of the high-frequency field caused some attenuation, while exposure to a field of 2500 v./cm. at wave-lengths 3·1–3·4 m. produced only a slight additional effect (that is, a slight increase in the minimum lethal dose for mice). In these experiments, however, the toxin was actually exposed to the field for only 17·5 min. A 1 per cent aqueous solution of tetanus toxin kept for some hours in a thin layer between varnished metal plates or walls of Monax glass lost most of its toxicity. This destruction was just prevented by addition of 0·2 per cent of rabbit serum. After exposure of such a film (0·8 c.c.) to the field (1000 or 3000 v./cm., $\lambda = 3{\cdot}1$–$3{\cdot}4$ m.) for 3 hours, the toxicity was exactly the same as that of the control film. *A distinct specific effect, therefore, was absent.* A generalization of this result would be premature before investigations on other toxins of different properties were completed.

It may be added that, contrary to Schliephake's brief statement[6], the viscosity of serum from defibrinated ox blood, protected from undue heating, was not altered after exposure to a 3·6 m. field. The frequency-independent effect predicted by Krasny-Ergen can be expected to occur only during exposure.

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Nov. 24.

[1] See, for example, Curtis, W. E., Dickens, F., and Evans, S. F., NATURE, 138, 63 (1936).
[2] Szymanowski, W. T., and Hicks, R. A., *J. Infect. Dis.*, 50, 1 (1932).
[3] Hicks, R. A., and Szymanowski, W. T., *J. Infect. Dis.*, 50, 466 (1932).
[4] Krasny-Ergen, W., *Radiologica*, 1, 136 (1937).
[5] Bateman, J. B., and Rosenberg, H., Report of the Intern. Congr. for Short Waves, Vienna, 1937, p. 129. There are some misprints in the numerical values.
[6] Schliephake, E., "Kurzwellentherapie", p. 52 (2 Ed., Jena, 1934).

Classification of Taxes and Kineses

IN recent years, the study of animal reactions to elementary physical stimuli has extended greatly, both in the laboratory and in the field. During this process, it has been necessary to modify somewhat Kühn's[1,2] classification based on the externally observable characteristics of locomotory reactions of this kind. Recent work by Ullyott[3] indicates a way in which the classification and terminology can be considerably simplified and improved.

Working on the light reactions of a planarian, *Dendrocœlum lacteum*, Ullyott showed that the classical avoiding reaction[4] can be regarded as a special case of a more generalized reaction. If *Dendrocœlum* is tested in a smooth gradient of light which has no horizontal component, as it moves towards the brighter end it makes increasingly frequent turning movements; if the animal is kept in constant stronger light, the initial higher frequency of turning falls off owing to sensory adaptation. This combination of differential frequency of turning and adaptation leads to aggregation in regions of lower light intensity, provided that the gradient is of suitable steepness. This behaviour can scarcely be described as an avoiding reaction (cf. *Paramecium*, Jennings[4]). Nevertheless, the same mechanism is probably involved when the animal shows an avoiding reaction at the edge of a shadow. The terms *avoiding reaction* and *trial and error* are thus objectionable, not only because they describe a particular form of the reaction and not its general form, but also because they are not sufficiently objective. The term *phobo-taxis* is objectionable too, because the prefix *phobo-* is in common use in English, with an anthropomorphic implication, and because the reaction given this name is the only undirected one which is called a *taxis*.

We therefore propose the following modifications of the nomenclature. Variations in generalized, undirected, random locomotory activity due to variations in intensity of stimulation are *kineses*. Such variations can be of two kinds, namely, changes in linear velocity, and changes in rate of change of direction (Ullyott's *R.C.D.*) or angular velocity. We propose to divide kineses into (*a*) ortho-kinese (ὀρθός—direct, forward)—variations in linear velocit (previously called simply *kineses*); and (*b*) klino kineses (κλίνειν—to deviate)—variations in angula velocity. The prefix *klino-* is free from anthropo morphic inplication. The whole word *klino-kinesi* can be used to describe the kind of reaction discusse by Ullyott, as well as other 'avoiding reactions' an 'phobo-taxes' which have not yet been demonstrate to be either like or unlike it in their details.

If this change is made, the word *phobo-taxis* ca disappear, and the word *taxis* can be reserved fo directed reactions, formerly called *topo-taxes*. Thi last word, therefore, also becomes unnecessary, and i is the more desirable to drop it because it is so simila to *tropo-taxis* in appearance and sound. We thu propose to add two prefixes to the nomenclature, i *ortho-kinesis* and *klino-kinesis*, and to remove two, i *phobo-taxis* and *topo-taxis*, so that the classification clarified without becoming more cumbersome.

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Nov. 19.

[1] Kühn, A., "Die Orientierung der Tiere im Raum" (Jena, 191
[2] Fraenkel, G., *Biol. Rev.*, 6, 36 (1931).
[3] Ullyott, P., *J. Exp. Biol.*, 13, 265 (1936).
[4] Jennings, H. S., "Behaviour of the Lower Organisms" (Londo 1906).

Variations in Copepod Development

AN interesting phenomenon has just been brough to my notice on reading a paper by Martin V Johnson on the development stages of *Eucalan elongatus*[1].

In a paper which I published last year[2], I describe the early stages of this copepod from material take off the west coast of Scotland. The two descriptio correspond very closely except in one particular, f whereas I found only five stages in the nauplius li (the earliest corresponding to other calanoid naup at Stage II), Johnson finds all the six stages repr sented. Since Gurney in the Discovery Repo No. 9 (1934) finds a similar state of affairs in *Rhi calanus* (that is, only five nauplius stages), I am l to the conclusion that with *Eucalanus* there is difference in the development between Californi where Johnson's material was obtained, and the we coast of Scotland.

In searching for an explanation of these difference it is natural to turn to the hydrographical conditio of the areas concerned. The Eucalanids are warr water forms and exist in the colder regions on by virtue of the warm-water currents which bri them there. In both Gurney's material and mi the specimens were taken from water of which t temperature was some 10° lower than that of t area supplying Johnson's material. It seems, ther fore, not impossible that the suppression of stages development might be correlated with temperatu and further observations in this direction shou prove of interest, especially as the incubation peri of the eggs of *Calanus* appears to be lengthened the lowering of temperature. Can it be that in the case of a warm-water copepod species breeding in unusually cool surroundings the incubation period may be so prolonged that the animal emerges from the egg in the second nauplius stage ?

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Nov. 16.

[1] *Trans. Amer. Mic. Soc.*, **56**, Jan. 1937.
[2] *Ann. Mag. Nat. Hist.*, Sept. 1936.

Effect of Spraying Solutions of Growth Substances on the Inflorescences of the Florists' Chrysanthemum

THE florists' chrysanthemum exists in many forms, two of the commonest being normal 'double' and 'incurved'. In both, the inflorescence consists entirely, or almost entirely, of ligulate flowers, but the 'incurved' type is distinguished from the normal 'double' type by the fact that in the former the corollas of the flowers constituting the mature inflorescence remain incurved. Experiments carried out here in which inflorescences of the double chrysanthemum (var. 'Gold Standard') were sprayed with solutions of two growth substances indicate that the difference between these two types of chrysanthemum may be a simple physiological one. The two growth substances used were β-indoleacetic acid (heteroauxin) and α-naphthalene acetic acid. Aqueous solutions of these growth substances of a concentration of 0·05 per cent were sprayed on to partially opened inflorescences by means of an atomiser.

In the unopened bud of the inflorescence the corolla of each flower is rolled longitudinally and folded laterally, and during opening there is a longitudinal unrolling and a lateral unfolding of the corolla of each flower. When partially opened inflorescences are sprayed in the manner described above, corollas which at the time of spraying are mature are unaffected by the treatment. Corollas which at the time of spraying are unrolling exhibit some reversal of movement and become incurved. Corollas which at the time of spraying are still rolled have their normal unrolling inhibited whilst the lateral unfolding proceeds normally and the flower becomes a typical 'incurved' one. The results are the same whether the treatment is applied to inflorescences attached to, or detached from, the parent plant.

Although these experiments have been carried out with synthetic growth substances, the resemblance between the effect of natural auxin and synthetic growth substances in other directions is so striking, that it appears possible that one of the fundamental differences between normal 'double' and 'incurved' chrysanthemums may be a difference of growth substance metabolism.

With single chrysanthemums (vars. 'Single Bronze' and 'Cleopatra') a similar inhibition of corolla unrolling has been obtained, whilst in the latter variety some 'outcurving' of apparently mature corollas was noticed.

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Force Constants and Molecular Structure

IN previous papers[1] we have described measurements on the ultra-violet absorption spectrum of carbon suboxide, and have attempted to calculate the force constants of the linkages in this molecule from the measured normal vibration frequencies. A potential function was employed involving four constants, two of these representing 'cross-term interactions'. Unfortunately, at the time only the two symmetrical frequencies ($\nu_1 = 843$, $\nu_2 = 2{,}200$) were known accurately from the Raman data, and it was necessary to assume plausible values for the cross-term constants in order to obtain values for the main constants. Lord and Wright[2] have now published infra-red data from which the two unsymmetrical frequencies may be deduced ($\nu_3 = 2{,}290$, $\nu_4 = 1{,}570$). We thus have four frequencies and four undetermined constants. Insertion of the values gives $k_{CC} = 12{\cdot}69 \times 10^5$, $k_{CO} = 15{\cdot}0 \times 10^5$, $k_{24} = 5{\cdot}10 \times 10^5$, $k_{13} = 2{\cdot}43 \times 10^5$. k_{24} and k_{13} represent C—C—C and O—C—C interactions of the type previously suggested.

The new values of the main constants differ slightly from those previously found, but strengthen the hypothesis then suggested, that the bonds are intermediate between double and triple and that the molecule appears as a resonance hybrid. Moreover, the relatively high value of the interaction term k_{24} in such a molecule is in accordance with other related results, for which a reason was previously suggested. When applied to the relations of Badger and Clark connecting force constant and bond length[3], the new values of the force constants give good agreement and much better than the old. We find for the C—C bond, with Badger's formula $r = 1{\cdot}18$ A., with that of Clark $r = 1{\cdot}165$ A., the electron diffraction value being $1{\cdot}20 \pm 0{\cdot}02$ A.; for the C—O bond $r = 1{\cdot}21$ A. (Badger), $1{\cdot}265$ A. (Clark) and $1{\cdot}29 \pm 0{\cdot}03$ A. (observed).

We should like here also to refer to a recent note in NATURE by Bailey and Hale[4] which seems to misinterpret calculations we have recently made of the force constants of linkages in ethylene and tetrachloroethylene[5], and to raise objections which are invalid. Bailey and Hale point out the necessity of removing uncertainty as to what any particular force constant implies, and also the necessity of considering as far as possible molecules of the same symmetry type. They also refer to the difficulties involved in using a too artificial force field and point out that the calculations only refer to infinitesimally small amplitude. These matters, with others, are fully discussed by us in our detailed papers, and some of the arguments of Bailey and Hale are precisely those which are used by us. So far as the subsequent calculation for the case of ethylene and tetrachloroethylene is concerned, its merits and demerits are fully discussed by us in the paper referred to.

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[1] *Proc. Roy. Soc.*, A, **157**, 331 (1936); *J. Chem. Soc.*, 1291, 1384 (1937).
[2] *J. Chem. Phys.*, **5**, 642 (1937).
[3] *J. Chem. Soc.*, 1396 (1937).
[4] NATURE, **139**, 112 (1937).
[5] *J. Chem. Soc.*, 1376, 1384, 1393 (1937).

Races with a High Proportion of Blood Group *AB*

IN a "Research Item" in NATURE of October 2, the failure of Miss Macfarlane to confirm the high percentage of Group *AB* previously found in Tibetans is reported. May I quote another race with a high proportion of Group *AB* ?

In an investigation of 1,000 Soussoux in French Guinea, J. S. de Goldfiem[1] obtained the following results.

BLOOD GROUPS OF SOUSSOUX

	No.	*O*	*A*	*R*	*AR*
Adults	500	1%	1%	9%	89%
Children	500	1%	1%	9%	89%

This race is of interest in that the percentage of *AB* exceeds 50 per cent which is the theoretical maximum in a stable race, for, where p, q and r are the frequencies of genes *A*, *B* and *R* respectively, then $p + q + r = 1$ and $2\ pq = AB =$ a maximum $= 0{\cdot}50$, where $p = 0{\cdot}50$ and $q = 0{\cdot}50$.

A race having this group distribution could arise as the result of the mating between a race having more than 90 per cent *A* on one hand and a race having more than 90 per cent *B* on the other, but this group distribution would only appear in the first generation—and stability would be reached in the second. For example, in the race in question, the *A* and *B* children arising from the matings between *AB* and *AB* only would form nearly 40 per cent of the total children, using the formula: A children from $AB \times AB$ matings $= 100\,\frac{(AB)^2}{4}$ per cent of total children.

A mutation occurring in this race at the present time could not, I think, give rise to this phenomenon.

It must be pointed out that Beth Vincent's technique was used for this observation.

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Nov. 11.

[1] de Goldfiem, J. S., *C.R. Soc. Biol.*, **123**, 391 (1936).

Anomalous Dielectric Constant of Artificial Ionosphere

APROPOS our letter in NATURE of October 2, p. 586, it has been pointed out to us by Prof. E. V. Appleton and Dr. F. W. Chapman that though the curves delineating the variations of μ^2 with N and $1/f^2$ are quite correct, they cannot, however, be regarded as showing the relation between K and N, or $1/f^2$. In fact μ^2 can be identified with K only when $\nu = 0$. In the general case, for a conducting medium, $\mu^2 = K + \frac{c^2k^2}{p^2}$. Thus, though μ^2 can take up values both greater and less than unity, as depicted in Figs. 1 and 2 of our letter, K cannot do so because $\mu^2 - \frac{c^2k^2}{p^2}$ can only have values equal to or less than unity.

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Points from Foregoing Letters

A TABLE showing the amounts of radioactive phosphorus (relative to the total phosphorus) in the yolk of eggs, the liver and the blood of a hen, 28 hours after it had been administered by subcutaneous injection, is submitted by L. Hahn and Prof. G. Hevesy. From the present and previous experiments the authors infer that the liver of the hen (and not the blood corpuscles) is responsible for the formation of the phosphatides. These are then carried by the plasma to the ovaries.

A curve showing the usual form of the phase variation of the abnormal component of low-frequency radio waves near sunset is given by K. G. Budden and J. A. Ratcliffe; also an example of a type of disturbance of the curve which, the authors find, is connected with 'fade-outs' or with magnetic anomalies. They conclude that a 'catastrophic' ionospheric disturbance decreases the reflection height of the low-frequency waves.

By applying a magnetic field (16 gauss) to a low-pressure bulb containing 'gas' ionized by short radio waves (6 m.), E. W. B. Gill has been able to reduce considerably (to $\frac{1}{400}$th) the ionizing potential needed for producing an electrodeless discharge. The author states that his experiments confirm Prof. V. A. Bailey's theory on what happens to wireless waves in the upper atmosphere.

J. W. Thompson, Wm. Corwin and J. H. Aste-Salazar find that, as compared with normal persons, the mentally unbalanced (schizophrenic) individuals show less physiological susceptibility to changed external conditions. Generally speaking, they have regular respiration, small tidal air and cardiac output, low blood pressure, low basal metabolic rate, high arterial carbon dioxide and low oxygen saturation.

The activity of tetanus toxin is found by Drs. J. B. Bateman, H. Loewenthal and H. Rosenberg to be unaffected by a high-frequency field (radio waves of 3 m. length and potential gradient of 2,500 v./cm.) when conditions were such as to prevent heating.

Dr. D. L. Gunn, J. S. Kennedy and D. P. Pielou propose alterations in Kühn's classification of animal reactions. The new terms make clearer the relations between the various reactions, they are not anthropomorphic like some of those discarded, and confusion between them no longer arises from their similarity of pronunciation.

Dr. S. G. Gibbons directs attention to observed differences in the development of the copepod *Eucalanus elongatus* in Californian as compared with Scottish waters. He asks if it is possible that the colder temperature of the water off the west of Scotland may prolong the incubation period so that the animal emerges from the egg in the second nauplius stage.

Using recent additional information on the infra-red spectrum of carbon suboxide, Dr. H. W. Thompson and J. W. Linnett have recalculated the force constants of the linkage in the molecule of that compound. The new values, they state, strengthen the hypothesis that the bonds are intermediate between the double and the triple types.

Research Items

Sinanthropus VI

SOME important inferences are drawn by Prof. Franz Weidenreich (*Bull. Geol. Soc. China*, 16; 1936–37) from fragments of a skull of Peking man designated as *Sinanthropus* VI, which have been brought together in the laboratory from material collected in the Choukoutien cave from 1934 onward. These consist of a fragment of a right temporal bone, comprising the ear aperture and adjacent parts (belonging apparently to the same skull as the left temporal bone and adjacent parts found in 1934 and already described), three teeth, two molars and a premolar, as well as two fragments of a skull, of which one is the greater part of a left parietal, while in material from the same level as the three teeth were the right side of a frontal bone and the anterior part of the squama of a right temporal bone. It is considered certain that all these pieces belong to one and the same skull—an adult (old) female. From these fragments it has been possible to form a general idea of the contour of the frontal portion of the skull, which on comparison with *Sinanthropus* I and *Pithecanthropus*, shows much less curvature than Skull I in the saggital planes and approaches very closely to the frontal bone of *Pithecanthropus*. In a frontal direction between the inferior temporal lines of both sides, it is less curved than Skull I and indeed is even flatter than *Pithecanthropus*. On a profile view, Skull VI coincides practically in all its lines with those of *Pithecanthropus*. A further discovery is a very small fragment, in certain respects, however, of very great importance. This is the right moiety of the posterior arch of an atlas. There cannot be any doubt that this is a human first cervical vertebra, and that it belongs to *Sinanthropus*. It does not display any distinct fundamental difference when compared with that of recent man. Its interest lies in the fact that it adds support to the view put forward on the evidence of the absence of long bones from the cave, that the skulls were brought into the cave by man and were there broken at the base or split open in order to get at the brains.

Bull Cults of Ancient Egypt

A DISCOVERY which should be of considerable interest for the study of the bull cult in ancient Egypt, when fuller details are available, is reported from Cairo. Dr. Drioton, director-general of antiquities, it is reported by the correspondent of *The Times* in the issue of December 13, has announced the discovery near Zagazig of twelve large granite sarcophagi, which had formerly contained the mummies of sacred bulls, dating from the fourth century B.C. Although these tombs had suffered, presumably from the activities of grave robbers, the internal decoration of three of the sarcophagi is said to have been sufficiently well preserved for it to be possible to make out that they dealt with the future destinies of the sacred bulls, an aspect of the bull cult which thus becomes known for the first time. According to Dr. Drioton's report, it would appear that the sacred bulls were introduced by their patron divinities into the assembly of all the gods. Further, that the outstanding feature of the posthumous destinies of the sacred bulls was their reunion with the moon. This is new to Egyptology. Near the sarcophagi of the sacred bulls were found small chambers, in which were mummies of sacred falcons, with their eggs buried beside them in jars. Further excavations are to be carried out on the site.

Temperature and the Growth of *Drosophila* and of *Lymnæa*

THE influence of temperature on the dimensional characteristics of *Drosophila melanogaster* has been investigated by several biologists. These studies concern only the final growth stage, while growth and development of this insect in the larva and pupa form the subject of a recent paper by Mr. Takeo Imai (*Sci. Rep. Tôhoku Imp. Univ.*, 4th Series (Biology), **11**, 403–417; 1937). It is shown that temperature influences the larval length, length of mouth armature and pupal length, in that high temperature causes a diminution of their dimensions. Two diverse hypotheses are held in regard to the explanation of thermal effect on size. In one case, it is considered to be dependent on the nutritional condition; diminution of size at high temperature is the result of a deficiency of food. In the other, it is maintained that the thermal effects result in modification of the chemical equilibrium. This latter view is held by the author, who suggests that high temperature produces effects that are connected with modification of the metabolic balance of the growing system; or, in other words, the balance between anabolism and katabolism is suggested as the cause of the morphological differences described. In a second paper in the same journal (pp. 418–432) the author formulates the same explanation with regard to the effects of temperature on larval shell size in the mollusc *Lymnæa*. It appears that growth of the larval shell occurs in two cycles, but while higher temperatures cause acceleration of development, the final shell size is diminished at both growth-cycles.

Associated Growth of Herbage Plants

A SERIES of three very interesting papers upon the physiology of pasture grasses when grown in association with legumes has been received from Australia (*Bull. Council for Sci. Ind. Research*, No. 105. Pp. 40+10 plates. Melbourne, 1937). A first paper by Messrs. H. C. Trumble and T. H. Strong indicates that no evidence has been obtained for the view that grasses are able to derive nitrogen from associated legumes during the vegetative stages of the latter, though the subsequent decay of nodules releases nitrogen to the soil. The other papers are written by Messrs. H. C. Trumble and R. E. Shapter, and discuss the physiology of specific associations of grasses and legumes. Yield of Wimmera rye-grass is increased by manuring with both phosphorus and nitrogen, whilst the yield of subterranean clover is raised by phosphorus only. The mixture gives increased yield with phosphorus at all levels of nitrogen. Many other results are given in detail, and the practical conclusion is that the greatest increase in production from the podsolized soils of southern Australia is to be obtained from liberal dressings of soluble phosphate to an associated crop of grass and suitably inoculated legume. The third paper shows that a perennial grass, namely, *Phalaris tuberosa*, may obtain considerable nitrogen from an associated annual legume such as *Medicago denticulata*, which grows rapidly, and presumably begins to decay at an early stage. The grass obtains approximately 30 per cent of the nitrogen present in the root system of the legume in this particular combination.

Genetics of Rice

THE genetics of rice is receiving considerable attention in India. Mr. B. S. Kadam crossed a wild Bombay rice, which sheds its grains completely, with a non-shedding Burmese variety (*Proc. Indian Acad. Sci.*, 14, No. 3). He found the shedding character completely dominant and caused by two duplicate genes. Ramiah and Rao, in a similar cross in south India, found the F_1 intermediate, and evidence of more than one gene. Mr. Kadam also found (*J. Indian Bot. Sci.*, 14, No. 2) that in a Burmese variety which develops anthocyanin in its roots when exposed to sunlight, the condition was determined by two complementary genes, *A*, without which no colour can appear in the plant, and R_0, a specific gene for root colour. By crossing two Indian varieties (*J. Heredity*, 27, No. 10) he found that one possessed a gene which produces red pigment throughout the plant, while the other contained an inhibitor which prevented anthocyanin developing in the leaf blades. Messrs. Kadam, Patil and Patankar (*Indian J. Agric. Sci.*, 7, No. 1) found from various crosses of rice varieties no hybrid vigour in respect of height, tillering, panicle-length or weight of the plant, but an increased yield in some crosses.

Atomic Weight of Carbon

THE atomic weight of carbon has been changed in the current report of the Committee of Atomic Weights of the International Union of Chemistry from 12·00 to 12·01, largely on the basis of gas density and mass-spectrograph measurements, which were confirmed by Baxter and Hale (1936–37), who obtained the value 12·010 from the combustion of hydrocarbons. A. F. Scott and F. H. Hurley (*J. Amer. Chem. Soc.*, 59, 1905; 1937) have now determined the ratio of benzoyl chloride to silver, the chloride being hydrolysed and precipitated as silver chloride. With the current international values for hydrogen, chlorine and silver, the value C = 12·0102 was found. With the value H = 1·0081, the value becomes C = 12·0100, and the same figure is obtained if 107·879 is used for silver. The same authors (*ibid.*, 2078) have used the value C = 12·010 to recalculate the atomic weight of sodium from the ratios involving sodium carbonate. With the current international values for silver, bromine and iodine, three values of 22·993, 22·993 and 22·994 are obtained, about 0·003 lower than the international value for sodium of 22·997, but in agreement with the value 22·994 found by Johnson in 1933 from the ratio NaCl : Ag. No mass-spectrograph value is available.

Magnetostriction

WHEN magnetic material is placed in a magnetic field, small changes in its physical dimensions take place. This phenomenon is known as magnetostriction, and although studied by Kelvin and Bidwell about seventy years ago, it is only recently that it has attained both theoretical and practical importance. It is applied usefully in practice in connexion with the magnetostriction oscillator and the magnetostriction echo-depth recorder. There are othe physical phenomena connected with it, such as th changes it brings about in the magnetic propertie of the material, known as the Villari effect. In sof iron, for example, the permeability is increased i weak fields but in strong fields it is weakened. Thi is usually referred to as the 'Villari reversal'. I the *Beama Journal* of October, W. Alexander an J. Swaffield describe some of the practical applications of magnetostriction. An important applicatio due to Pierce is to use it for starting and controllin electrical oscillations. A special valve oscillato works on this principle. The magnetostriction echo depth recorder is used for taking soundings at se and has now reached the commercial stage. Th principle is to transmit through the hull of th vessel a high-frequency sound impulse generated i a special type of magnetostriction oscillator. This i reflected from the sea-bed and recorded by apparatu similar to the transmitter but acting in the invers way, the sound impulse being converted into a electrical one. After amplification and rectificatio the voltage produced is applied to a chemical recorde and produces a mark on paper. The time whic elapses between the transmission of the impulse an the marking of the paper is a measure of the dept at any instant. Thus the chain of dots forms continuous trace giving the configuration of the sea bed. In the United States a magnetostriction oscillator has been developed which produces intense audibl vibrations of frequencies of 8000 cycles per secon capable of fracturing glass and of producing usef bactericidal effects.

An Annual Change in Longitudes

IN *Mon. Not. Roy. Astro. Soc.*, 97, 9, October 193 Dr. Frank Schlesinger has a paper with the abov title, in which he disputes the conclusions of Loomi and Stetson that longitude changes between Washington and Greenwich as well as Paris are correlate with the hour-angle of the moon. Kawasaki showe quite recently that these changes in longitude coul be equally well represented by an annual term whic is completely independent of the position of the moon and Schlesinger now treats the whole material as unit. His results show that the evidence is in favou of the annual hypothesis as against the lunar, and h seeks for some causes for the annual change i longitude. Consideration is given to the wandering of the earth's pole of rotation with respect to a fixe axis in the earth, and this would give rise to variation in latitude, longitude and also in azimuth. Th latitude variations have been well observed at th Cape Observatory, Washington and at other places and a simple expression is given which connect longitude and latitude changes. Using this fo Washington, differences of longitude are compute between this station and Greenwich as well as Pari On comparing these with the observed difference the agreement is as close as might be expected betwee Washington and Paris, but is not so good betwee Washington and Greenwich. It is suggested that th polar motion is at least a partial explanation, an may be a complete explanation of the longitud changes which have been found to exist betwee Paris and Washington. Large differences betwee Paris and Greenwich still exist, and if these could b cleared up the polar motion could practically b accepted as an explanation of the Greenwich Washington changes in longitude also.

British Institute of Radiology

ANNUAL CONGRESS AND EXHIBITION

THE eleventh Annual Congress and Exhibition of the British Institute of Radiology was held, as usual, at the Central Hall, Westminster. The Congress was opened on December 8 by the president, Dr. R. J. Reynolds, in the presence of Her Majesty Queen Mary, who, before the opening ceremony, made a tour of the Exhibition and took a great interest in the various items shown.

The papers read at the Congress dealt with X-rays in industry, the medical ones treating the use of X-rays in industrial diseases, and the physical papers dealing with X-rays in industrial research. The latter symposium, held on December 9, was opened by Dr. G. Shearer, who pointed out that technical advances in materials followed largely on advances in the detail with which the materials could be studied. Great progress had followed improvements in the microscope, while the development of the 'X-ray microscope', which revealed the inner structure of materials, had resulted in further striking developments. Among the main properties of solids revealed by X-ray methods were their compositions, grain sizes, the orientations of the constituent crystals and their states of perfection. As examples, he quoted the importance of grain size in paints and electrolytic deposits, and stated that imperfectly formed crystals were desirable in steels intended for permanent magnets and perfectly formed crystals for transformer steels.

Dr. H. J. Gough and Mr. W. Wood read a paper on the use of X-ray methods in the investigation of failure in service, which dealt with one phase of the problem of fatigue. Stressing the importance in design of an accurate knowledge of the strengths of materials, the authors pointed out that apparent strengths depended markedly on whether the stresses were continuous or cyclic. From a knowledge of atomic constitution it was possible to deduce values for the strengths of materials, but these were usually found to be far greater than those obtained in practice. It had been thought that the discrepancy was possibly due to flaws, but in that case it was difficult to understand how relatively consistent values of the strengths could be found. Even before X-ray studies were undertaken, it had been found that the failure might be due to some change in the micro-structure of materials, particularly of metals. X-ray studies of stressed metals had shown that the sizes of the crystal grains remained constant over the region in which Hooke's law was obeyed, but at the yield-point there was a break-down in the crystal grains, which continued until a more or less homogeneous 'crystallite' structure was obtained. This breaking-down of grains seemed to give a power of accommodation to the material, and fracture only occurred when all the grains had broken down and the accommodatory power ceased. With cyclic stresses similar phenomema were observed, with the important difference, at present not understood, that deterioration of the material in this case is local, whereas with continuous stresses it is general. The authors stated that many problems remained unsolved, one of the most important being the reason for the crystallite structure, which implies a kind of 'crystal molecule'.

Dr. W. T. Astbury discussed X-rays and wool fibre, pointing out that wool, in common with other organic materials such as hair, horn, muscle, etc., consists of bundles of long polypeptide chains somewhat like a 'sliver' of wool on a minute scale. Wool, he said, is characterized by great elasticity and in favourable circumstances can be stretched to twice its natural length, and will recover when the stress is removed. Study of the material by X-rays and by other methods showed that wool has a kind of 'step-ladder' structure consisting of long chains of molecules, cross-linked by side chains. The chains were normally folded, but in the presence of water the chains could be straightened and would recover. This accounted for the power of recovery of shape by woollen garments after stretching when wet. At higher temperatures (steam) the side-chains were hydrolysed, and the material largely lost its power of recovery. This fact was made use of in various industrial processes including the 'permanent' waving of hair. X-ray studies had revealed clearly two definite states, normal and hydrolysed, and had shown the underlying nature of the change.

Dr. A. J. Bradley and Mr. H. Lipson read a paper on a "Rapid Survey of Ternary Alloy Systems by X-rays", pointing out that at present it is not known why the various alloys of three metals, for example, copper, nickel and iron, have such varied properties. The crystalline form of the alloys is usually cubic and most commonly consists of face- or body-centred cubes, and often a mixture of both. Although microscopic examination will show the main features of the systems, careful X-ray examinations are necessary to find the complete diagram, as in many cases the various zones are very narrow. The authors stressed the particular necessity of studying the alloys in great detail so that the finer points should not be missed.

The twentieth Silvanus Thompson Memorial lecture was given by Prof. J. A. Crowther, his subject being "The Biological Action of X-rays: a Theoretical Review". Pointing out that, on account of simplicity of experiment, most recent research had been carried out with single-celled materials, Prof. Crowther said that the cells showed marked variations in radio-sensitivity during their life-history, young cells being more sensitive than older ones and cells about to divide being particularly sensitive. Lethal doses of X-rays ranged from 40 röntgens for the most sensitive states to 35,000 röntgens in the insensitive states. Intermediate doses, insufficient to cause the death of the cell, may prevent normal cell-division and may produce mutations. It appears that the sensitive unit is not the complete cell or its nucleus, but some smaller structure, possibly sub-microscopic in size. This might account for the insensitivity of normal cells, which are virtually homogeneous structures.

Considerations of the energetics show that such effects can only reasonably be expected on the basis of a localized quantum action. Two theories of the mechanism of radiation-action had been put forward, one based on the possibility of a poison being formed, and one suggesting a direct or 'bullet' action, which may be due to the direct action of the quantum of radiation energy, to the production of an ion-pair or to the passage of an electron track through the sensitive part of a cell. Consideration of wave-length effects should ultimately show which is the true explanation.

Dealing with the two theories as to the mechanism, Prof. Crowther pointed out several objections to the poison theory : the objection that the amount of poison was small (100 r. producing a concentration of the order of 1 poison molecule in 10^8 normal molecules) was not considered valid, but other evidence concerning temperature effects, variations of effects with dosage rates and times seemed to point against the theory. Further, the known survival and mortality curves could only be considered consistent with the poison theory on the basis of certain unlikely assumptions. On the other hand, the 'bullet theory' rationally explained most of the observed facts, including the insensitiveness of the reactions to temperature variations. In due course it might be hoped that the mechanism would be understood, and at present Prof. Crowther thought that possibly the root cause of radio-biological action might be found in the variations of the electric charges on colloidal particles when irradiated.

The Research Section of the Exhibition contained exhibits from fourteen individuals and institutions, illustrating research in technical, biological and physical problems, and included examples of early apparatus and radiographs. In the Industrial Exhibition was shown a commercial X-ray tube for operation at 1,000 kilovolts. In this tube the electrons are excited in three stages, each of 400 kilovolts, and the tube may be operated either with one pole earthed or in the balanced arrangement.

Nicotinic Acid and the Pellagra-Preventing Vitamin

IN an address to the Birmingham University Biochemical Society, on December 9, Dr. Leslie Harris, of the Cambridge Nutritional Laboratory, referred to the findings in some current work on the chemical nature of the pellagra-preventing factor.

Dr. Harris said that the suggestion of a connexion between nicotinic acid and 'vitamin B' is not a new one. About twenty-four years ago, Funk in England and Suzuki in Japan succeeded in isolating nicotinic acid from active 'anti-neuritic' concentrates, and it was once supposed that nicotinic acid might in some way be related to vitamin B_1. But later investigations proved conclusively that pure nicotinic acid itself had no anti-neuritic action, and there the matter was left for some years, although the possible physiological importance of nicotinic acid was emphasized by the discovery of Euler that the acid amide of nicotinic acid is a component of cozymase. Recently, however, it has been found that nicotinic acid or its amide has a growth-promoting action for certain micro-organisms (Knight, Mueller, Holiday), and for pigeons or rats kept on various diets deficient in some portion of the B_2 complex (Funk and Funk ; Frost and Elvehjem). Special importance attached to the statement of Elvehjem and his co-workers that nicotinic acid or its amide was curative of 'blacktongue' in dogs ; and work has now been done to link these new results with observations made at the Cambridge Nutritional Laboratory a year or so back. Here experiments by Birch, György and Harris showed that what had hitherto been called 'vitamin B_2' consisted in reality of three distinct factors, namely, lactoflavin, vitamin B_6 (the 'rat dermatitis factor') and the pellagra-preventing (P.P.) factor proper. The latter appeared to be identical with the 'anti-blacktongue' factor for dogs. More recently, Harris confirmed these results as to the tripartite nature of the 'vitamin B_2' complex and showed furthermore that monkeys also developed a disease ('monkey pellagra') analogous with human pellagra when restricted to a diet deficient in the P.P. factor but containing the other known constituents of the B_2 complex.

A trial of nicotinic acid on monkeys which were developing symptoms of nutritive failure on a diet deficient in the P.P. factor has now indicated that this substance has in fact a curative action : further work is needed, however, to ascertain whether nicotinic acid is the *sole* deficiency in such a diet. Nevertheless, these results and the findings of other workers seemed sufficiently encouraging to warrant a trial on human beings suffering from pellagra.

Through the collaboration of Dr. A. Hassan of the Faculty of Medicine, Cairo, tests under controlled conditions have been made on pellagrins in Egypt. In preliminary trials, two cases of spontaneously occurring pellagra at the Khanka Asylum and three at Abuzaabal Prison were examined, together with three controls. All variables, such as the composition of the basal diet, the amount of work done daily, and the extent of exposure to sunlight were kept unaltered for all subjects. Nicotinic acid given by mouth up to a maximum level of $\frac{1}{2}$ gm. daily was found to hasten the subsidence of the erythema in all the cases. At the asylum, the general condition of the pellagrins was likewise improved, but at the prison the beneficial effect seemed largely limited to the specific action on the erythematous lesions. It may safely be concluded therefore that the nicotinic acid duly rectified a deficiency in these pellagra-producing diets. The results make it seem likely that the prison diets were deficient in some additional factor, and in fact the asylum diet did contain more meat, more greens, was better prepared and included some wheaten bread—the bread at the prison consisting of one quarter of maize. The possibility has therefore still to be borne in mind that nicotinic acid is not the *sole* major deficiency in some pellagra-producing diets—in other words, that pellagra as sometimes seen may be accompanied by more than one dietary error. Apart from this, it seems probable that nicotinic acid (or amide) is the less active form, or 'precursor' of a more active variation of the P.P. vitamin, which can be formed from it within the animal body.

Cellulose, Starch and Glycogen

A VALUABLE article on recent work on cellulose, starch and glycogen, by Prof. H. Staudinger, has appeared in a recent issue of *Die Naturwissenschaften* (25, 673; 1937). The fact that cellulose, starch and glycogen can be converted into esters without altering the degree of polymerization, and can be reconverted into the original substances, as shown by molecular weight determinations, optical rotation and other properties, shows that the glucose residues in the colloidal particles of these substances are linked by principal valencies. The colloidal particles are therefore macro-molecules. The determination of the molecular weights of these substances is discussed. The ebullioscopic and cryoscopic methods are difficult to apply owing to the smallness of the effect, and other anomalies; but molecular weights can be satisfactorily determined from osmotic pressure data using the equation of Schulz, or by Svedberg's method using the ultra-centrifuge. It is also possible to determine them from viscosity data by an equation due to Staudinger. All these methods agree in giving a value about 200,000 for the molecular weight.

X-ray analysis shows the molecule of solid cellulose to be extended, and there is reason for believing that this is also the case in solution. Viscosity determinations show, however, that in starch there is a bending back of the molecules. Starch molecules are only about one eighth as long as they should be if extended. With glycogen, solutions of the same concentration have the same viscosity, no matter what the degree of polymerization. This points to the existence of spherical macro-molecules in this case. The linking of the glucose residues in these three compounds is discussed, and the connexion between physical properties and the shape of the molecule is emphasized.

Colloidal particles can be classified into two groups, linear and spherical colloids, according to the shape of the particles. The latter are powders in the solid state, and dissolve in water without swelling to give solutions of low viscosity. Linear colloids, on the other hand, are tough, fibrous substances, which dissolve with considerable swelling, and form viscous solutions. Glycogen is a typical spherical colloid, and its physical properties are not greatly altered by change in the size of the molecule. Cellulose is a typical linear colloid, and the physical properties depend a good deal on the size of the molecule. Starch occupies a position intermediate between cellulose and glycogen. A similar difference in structure of the macro-molecules is found in the case of the albumens.

The form of the macro-molecule of polysaccharides and albumens decides the different functions of these substances in the living organism. Cellulose forms the solid portions, whereas substances which have to be transported through the organism are spherical colloids.

Twenty-one Years of Glass Technology

THE subject of the presidential address delivered to the Society of Glass Technology at its twenty-first anniversary meeting at Sheffield by Prof. W. E. S. Turner was "Twenty-one Years. A Professor Looks Out on the Glass Industry". This address has now been published (Society of Glass Technology, Sheffield. Pp. 70+46 tables. 10*s*.; postage 3*d*.). Whilst its introductory and short concluding chapters are concerned mainly with the growth and development of the Society of Glass Technology and its international relationships, the major portion is occupied with an account of the great advances, mechanical, chemical and physical, which have revolutionized the ancient craft of glass-making throughout the world. The volume is one for the student of social history and of commerce as well as for those interested in the advances of applied science.

That the development of the completely automatic machine has been the dominant factor in influencing conditions in the industry during the period under review is brought out clearly by means of a carefully collected mass of evidence. The tendency to mechanization was already evident before 1916, as, for example, in the Owens' bottle machine which was brought to a commercial stage in the early years of the century, and by 1914 was in operation in ten European countries as well as in the United States. But its use was limited to a small number of licensees, and similar conditions prevailed with the few machines available in other sections of the industry.

During the intervening years, mechanical progress has been very rapid, and there are now in wide use seven or eight different types of bottle machine, as well as automatic machines for the manufacture of tumblers and other domestic ware, plate and sheet glass, electric lamp bulbs and tubing. The change has led to an enormous increase of productive power, as is evidenced, for example, by a growth of the annual output of containers in Great Britain between the years 1924 and 1935 by sixty-two per cent, or to take a still more striking example, of an increase of machine-made electric lamp-bulbs in Europe from 2½ millions in 1919 to 127 millions in 1932.

Concurrently with the advance of the machine has been the steady disappearance of the skilled glass-blower, for a single bottle machine may equal the output of more than fifty men, and, to take an extreme case, the most modern lamp-bulb machine, the Corning 399, has produced more than 500,000 bulbs daily, equivalent to the production of 500 glass-blowers. The same tendency has not been at work in other branches of labour, for there is evidence even of a slight improvement in total employment in the industry, due to the great increase of sales of glassware, largely induced by the cheapening of production, for which the machine has been primarily responsible.

Two other consequences have issued from the increased use of machinery. The first is the ousting of the small works and the concentration of production to an increasing degree in fewer but larger factories (the number of window glass works, for example, in the United States fell from 79 in 1919 to 18 in 1933). A second result has been a rapid world-wide spread of the industry, for the recent growth in many additional countries, of which Japan is an outstanding example, would not have been possible if it had depended on a supply of skilled glass-blowers.

With the development of machine production, and indeed rendered necessary by it, there has been a corresponding improvement in furnaces and refractory materials, in feeding devices for molten glass, and in lehrs for annealing the finished product.

In the striking advance here so admirably illustrated, the chemist and physicist, in addition to the engineer, have played a decisive part. To them has fallen such tasks as providing purer and more varied supplies of raw materials in ever-increasing quantities, and exploring the relationships between the chemical composition and chemical and physical properties of glasses so that a material most suitable for each type of production might be obtained. But the attention of the technologist has been by no means confined to the field of mass production, and a number of fresh developments in various fields during recent years testify to his industry. Among them may be cited 'Vita' glass, Safety glasses, Pyrex glass, Vitrolite, glass building bricks and modern glass wool or silk.

These and other advances in the art and science of glass-making have been reflected in the marked growth of technical training and research institutions and in the copious output of valuable literature, of which the *Journal of the Society of Glass Technology* is a striking example.

Science News a Century Ago

Debate on Civil List Pensions

IN the House of Commons on December 19, 1837, Mr. Rice, the Chancellor of the Exchequer, moved that the Civil List Bill be read a third time. To this, Mr. Grote, the historian, then M.P. for the City of London, replied by moving an amendment that the clause empowering Her Majesty to grant a certain sum [£1,200] annually should be struck out. He maintained that pensions ought no longer to be assigned at the mere arbitrary and irresponsible will of the Sovereign. The proper distribution of these involved a great public duty, and the House should take them under its control.

Sir Robert Peel, speaking against the amendment, said that the sum of £1,200 as a provision for the United Kingdom was too limited. The honorable gentleman [Mr. Grote] would do away with pensions altogether, but cases would arise—cases where it would be proved that men of science had devoted the energies of their minds and fortunes for the benefit of society, and then the country would revolt against the niggardly conduct of Parliament. A pension and an honorary dignity were on the same principle awarded by the Crown. Literary and scientific men should, in his opinion, receive pensions if they stood in need of them; if not, they should receive those conventional distinctions, which the Crown alone should have the power of conferring. Mr. Buller, the member for Liskeard, who agreed in the main with Sir Robert Peel, said it was almos impossible to point out one instance of a person wh had benefited his posterity either by his writings c his advancement of science, from the time of Chauc to the present day, who had not been supported b either the bounty of the Crown or the charity of son individual.

In the course of the debate, references were mac to Locke, Johnson, Southey, Wordsworth, Coleridg Dalton, Wollaston, Airy and Mrs. Somerville. M Buller also referred to the case of "Mr. Wallace, wh had been for many years Professor of mathematics Edinburgh, and who was second only to Ivory his talents or attainments, and yet when he appli for a pension he was refused: he considered this cruel case." Mr. Grote's amendment was lost 23 votes to 125.

Faraday's Experimental Researches

AT a meeting of the Royal Society on December 2 1837, Faraday continued the reading of his "Expe mental Researches in Electricity", Eleventh Seri The reading of the paper had been begun December 14 and its concluding portion was read January 11, 1838. The official abstract said: "T object of this paper is to establish two gener principles relating to the theory of electricity, whi appear to be of great importance: first, that indu tion is in all cases the result of the actions of con guous particles; and secondly, that different insu tors have different inductive capacities. . . . conclusion, the author remarks, that induction appea to be essentially an action of contiguous particl through the intermediation of which the electric fo originating or appearing at a certain place, propagated to or sustained at a distance, appeari there as a force of the same kind and exactly equ in amount, but opposite in its direction and tendenci Induction requires no sensible thickness in conductors which may be used to limit its exte . . . But with regard to dielectric or insulat media, the results are very different; for th thickness has an immediate and important influe in the degree of induction. As to their quali though all gases and vapours are alike, whatever their state, amongst solid bodies, and between th and gases, there are differences which prove existence of specific inductive capacity."

Naturalists in Abyssinia

"FRENCH and German naturalists," said *Athenæum* of December 23, 1837, "are overrunn Abyssinia in all directions. Letters have just b received from Schimper, who was sent by Würtemberg Naturalists' Society, to Africa. A sending home a collection of plants from the He and Mount Sinai, he arrived at Massawa in Janua where great obstacles were raised to his prosecut his journey, by the recent circumstance of two Fre travellers having been killed in Abyssinia. Howe he succeeded in reaching Arkíko and Haley, thence sent on to the Abyssinian King Wabeah, was encamped at Hazabo, between Adowa Axum, for permission and safe conduct. This granted, and he was soon welcomed at Adowa, king's capital, by the German missionaries, sent f England; Blumhardt and Isenberg. From the he intends to prosecute his scientific tour to Abyssinian Alps." Wilhelm Schimper was born Mannheim in 1804 and died at Adowa in 1878.

Societies and Academies

London

Royal Society, December 9.

R. W. GURNEY and N. F. MOTT : Theory of the photolysis of silver bromide and the photographic patent image. An attempt is made to explain the photolysis of silver halides in terms of the concepts of atomic physics. The mechanism by which the silver atoms formed by the light coagulate to form specks of metallic silver is discussed. The ideas used in this discussion are then turned to the photographic latent image, and are shown to account qualitatively for the variation of developed density with temperature, and, for given exposure, with intensity of light. A brief discussion is given of the Herschel effect, and of sensitization by dyes.

A. L. REIMANN : The temperature variation of the work functions of clean and of thoriated tungsten. Measurements were made of the contact potential difference between a constant source of electrons and a neighbouring tungsten filament collecting space-charge-limited electron current, the condition of which was varied. This filament was either clean or covered with a layer of thorium atoms, and, in addition, it was held at various temperatures. In this way direct information was obtained concerning the rates at which the work functions of clean and fully activated thoriated tungsten (W–Th) vary with temperature. Within the limits of experimental uncertainty there is no difference between the temperature coefficients of the two work functions. The temperature coefficient found is about that which would be required to account for the observed value of the thermionic constant A of clean tungsten on the assumption of practically perfect transmission. It must be concluded that the factor (of the order of 10–20) by which the A of W–Th is less than that of clean tungsten is due to internal reflection of electrons at the W–Th surface.

Paris

Academy of Sciences, November 3 (*C.R.*, 205, 761–824).

GEORGES CLAUDE : The search for aeroplanes lost at sea. Remarks on the use of fluorescin.

ROBERT ESNAULT-PELTERIE : The coefficient of self-inductance of a solenoid. Two approximate formulæ are suggested, one giving an accuracy of 3 per cent and the other of 0·1 per cent.

GEORGES GIRAUD : A new category of equations where the principal values of integrals are represented.

JEAN CABANNES and CHARLES BOUHET : An attempt at the classification of the Raman lines of a quartz crystal.

MARC KRASNER : The definition of certain non-commutative rings. The classification of the primitive extensions of bodies with discrete valuation.

E. J. GUMBEL : The generalization of Boole's inequality.

HENRI CARTAN : Filters and ultra-filters.

ERNEST VESSIOT : The equations $F(x, y, z, p, q, r, s, t) = 0$ which have a general explicit integral.

MICHEL GHERMANESCU : A new class of nuclei of Fredholm.

JEAN LERAY : The solution of the problem of Dirichlet.

JEAN DUFAY and SSU PIN LIAU : The colour indices of the O and B stars and the selective absorption of light in space.

GEORGES REBOUL and JEAN REBOUL : The ionizing radiations of low quantum emitted spontaneously by the ordinary metals. Ordinary metals, like the true radioactive metals, constantly emit radiations. These appear to belong to the bands situated in the region of the soft X-rays.

VITOMIR H. PAVLOVIĆ : An improved apparatus for the subjective study of colour mixing.

RENÉ BERNARD : Stimulation potentials of the B^3H and C^3H levels of the nitrogen molecule.

TIEN KIU : Remarks on photographic plates sensitized with salicylate.

ALEXANDRE TRAVERS and ROBERT DIEBOLD : The isolation of pure cementite by acid attack of ferrous materials and on some physical properties of this body. The product isolated contained 6·6 per cent of carbon, the theoretical figure being 6·67 per cent. The Curie point, electrolytic potential and X-ray spectrum were determined.

PAUL COUTURIER : The action of mixed organo-magnesium derivatives on some hydroxy or alkoxy aromatic amides.

PIERRE MASTAGLI : The reducing action of the alkaline benzylates on hydratropic and α-alkyl-cinnamic aldehydes.

GEORGES DUPONT and CHARLES PAQUOT : Some reactions of isoprene and of dimethylbutadiene.

GEORGES BRUHAT and ANDRÉ BLANC-LAPIERRE : The double refraction of quartz by compression and its dispersion in the ultra-violet.

GEORGES DÉJARDIN, ALBERT ARNULF and DÉMÈTRE CAVASSILAS : The absorption coefficients and average temperature of atmospheric ozone.

DAVID MALAN : Stormy discharges in the upper atmosphere.

RENÉ SOUÈGES : The embryogeny of the Convolvulaceæ. The development of the embryo in *Convolvulus arvensis*.

MARCEL GOMPEL : Researches on the oxygen consumption of some coastal aquatic animals.

PAUL WINTREBERT : Morphogenesis and epigenetic induction.

AUGUSTE and RENÉ SARTORY and JACQUES MEYER : The infection of cultures with a fungus by *Rhizoglyphus echinopus*, a parasite of the potato.

GEORGES MOUIRQUAND and HENRY TÊTE : Chronic food deficiency (partial C avitaminosis). Reversible and irreversible processes.

Moscow

Academy of Sciences (*C.R.*, 16, No. 4, 1937).

N. M. ERMOLAJEV : The expansion of an infinite integral into a semi-convergent series.

G. A. TIKHOV : The deviation of light rays in the gravitation field of stars.

A. A. ULJANOV : Radiations accompanying the corrosion of metals (1).

V. I. NIKOLAJEV and A. K. SENJUTA : Dehydration of mirabilite *in vacuo*.

A. IMŠENECKI : The morphology of large bacterial cells.

P. A. POVOLOČKO : (1) Chromosome morphology in *Punica granatum* L. (2) Causes of sterility in winter-grown plants of *Nicotiana tabacum*.

M. CH. ČAJLACHJAN : Concerning the hormonal nature of the plant development process.

B. A. ZENKOVIĆ : Food of the Far Eastern whale.

A. A. VOITKEVIČ : Morphogenetic activity of different parts of the hypophysis (6). Experiments with the implantation of the posterior part of the hypophysis to tadpoles.

V. V. POPOV and V. S. POPOV : Is the cornea of metamorphosed anurans determined ?

V. V. POPOV, S. P. EVDOKIMOVA and A. G. KRYMOVA : The lens-forming activity of the epidermis in larval and adult Amphibia.

V. V. POPOV, M. N. KISLOV, M. F. NIKITENKO and P. S. ČANTURIŠVILI : The lens-forming activity of epithelium in embryos of *Pelobates fuscus, Bufo viridis, Bombina bombina* and *Triton cristatus*.

Vienna

Academy of Sciences, October 14.

W. OBERHUMMER : Possibility of dissolving chromic oxide and chrome iron ore at room temperature. Silver nitrate catalyses the solution of chrome iron ore by dilute sulphuric acid.

GERTRUD WILD : Spectroscopic analysis of fluorites. The presence of rare earths in natural fluorites is confirmed.

E. EPSTEIN : Electrical precipitation of the disperse phase of organic and inorganic dispersoids by radium emanation. α-Particles cause a reduction of the charge and an increase in the size of the particles in phosphatide and gold sols, leading in the former case to flocculation and in the latter case to colour changes.

K. SCHWARZ and F. EBSTER : Apparatus for the production of electrons of very high energy.

F. SCHOSSBERGER : (1) Use of the fine structure of X-ray absorption edges for the determination of crystal structure. (2) Precision X-ray camera for obtaining powder diagrams at high temperatures, and an apparatus for measuring X-ray diagrams.

C. NEUBERG and C. H. SCHWIETZER : Agar-agar.

D. BALAREW : Application of the phase rule to crystal systems.

H. MACHE and O. MOSZKOWICZ : Ionization of air at low pressures by γ-rays : parabolic law for the ionization current. It is shown that if, for pressures greater than 100 mm., current-potential curves be plotted for various amounts of ionization, then points corresponding to the same degree of saturation all lie on a parabola.

H. PRZIBRAM, LEONORE BRECHER and MARTHA GEIRINGER : Colamin, the physiologically active component of choline.

F. MAUSER : Synchronous metamorphosis of the legs of *Dixippus morosus* Br. et Redt.

GERTA SCHMID : Conditions for the development of the imaginal red coloration on the fore legs of *Dixippus morosus* Br. et Redt.

O. HRABIK : Local transformation of solid and hollow bones of *Molge cristata* Laur. It is possible to interchange a hollow bone from one limb with a solid bone from another. In certain cases these bones become transformed so as to become appropriate to their new position.

A. W. REITZ and R. SABATHY : Studies of the Raman effect (78). Nitrogenous substances (8). Nitriles.

A. WARSBERG : Influence of morphine on the excretion of salt in the urine.

K. FEDERHOFER : Normal vibrations of spherical shells (2).

Appointments Vacant

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

JUNIOR SCIENTIFIC OFFICERS (chemist and engineer) at the F Research Station, East Greenwich—The Establishment Offi Department of Scientific and Industrial Research, 16 Old Qu Street, S.W.1 (December 30).

SENIOR LECTURER IN HIGHWAY ENGINEERING in the Univers of the Witwatersrand—The Secretary, Office of the High Commissio for the Union of South Africa, South Africa House, Trafalgar Squa W.C.2 (January 7).

LECTURERS IN CIVIL, ELECTRICAL AND MECHANICAL ENGINEER in the University of Cape Town—The Secretary, Office of the H Commissioner for the Union of South Africa, South Africa Hou Trafalgar Square, W.C.2 (January 19).

PROFESSOR OF MINERALOGY AND GEOLOGY in the University Cape Town—The Secretary, Office of the High Commissioner for Union of South Africa, South Africa House, Trafalgar Square, W (January 31).

ASSISTANT for research on various diseases of small fruits at East Malling Research Station, East Malling, Kent—The Secreta

Official Publications Received

Great Britain and Ireland

Royal College of Surgeons of England. Scientific Report for Year 1936-1937. Pp. 40. (London : Royal College of Surgeons England.) [15

Board of Trade. Statistical Abstract for the British Empire each of the Ten Years 1927 to 1936 (Trade and Commerce Sectio (No. 66.) (Cmd. 5582.) Pp. xv+229. (London : H.M. Statione Office.) 3*s*. 6*d*. net. [15

ULAWS Monographs and Reports, No. 2a : Report of a Discuss on the Destruction of Sea-Birds by Oil Waste, held at Univers College, University of London, on May 10, 1937. Pp. 16. (Londo University of London Animal Welfare Society.) [16

Twenty-one Years : a Professor looks out on the Glass Indust Being the Presidential Address delivered on the occasion of t Twenty-first Anniversary Meeting of the Society of Glass Technolo at Sheffield, November 9th, 1937. By Prof. W. E. S. Turner. Pp. (Sheffield : Society of Glass Technology.) 10*s*. [16

Science Museum : Board of Education. Catalogue of the Ato Tracks Exhibition (November 1937—February 1938). The Resu of 25 Years of Research by Prof. C. T. R. Wilson's Expansion Chamb Method, in which the Tracks of Individual Atoms and Electrons a rendered Visible and Photographed. Compiled by Dr. F. A. B. Wa Pp. 28. (London : H.M. Stationery Office.) 6*d*. net. [16

Other Countries

Annual Report of the Board of Regents of the Smithsonian Instit tion, showing the Operations, Expenditures and Condition of t Institution for the Year ended June 30, 1936. (Publication 340 Pp. xiv+446+122 plates. (Washington, D.C. : Government Printi Office.) 1.50 dollars. [15

Indian Forest Records (New Series). Vol. 3, No. 4 : Entomologic Investigations on the Spike Disease of Sandal (32) Lygaeidae (Hemipt By N. C. Chatterjee. Pp. 105–122. 8 annas ; 10*d*. Vol. 3, No. Cis Latr. et Anobiides nouveaux des Indes (Coléoptères). Par M. P Pp. 123–126. 3 annas ; 4*d*. Vol. 3, No. 6 : Immature Stages of Indi Coleoptera (22). By J. C. M. Gardner. Pp. 127–140. 12 annas ; 1*s*. (Delhi : Manager of Publications.) [15

Indian Central Cotton Committee : Technological Laborato Technological Bulletin, Series A, No. 38 : Technological Reports Trade Varieties of Indian Cottons, 1937. By Dr. Nazir Ahmad. P v+145. (Bombay : Indian Central Cotton Committee.) rupees. [15

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