NATURE

No. 3948 SATURDAY, JUNE 30, 1945 Vol. 155

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Editorial and Publishing Offices

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

SOCIAL SCIENCES AND THE CIVIL SERVICE

THE future position of the Civil Service in Great Britain turns on two fundamental factors: first, the adequacy of the methods at present in use in the Civil Service for handling the new and wider range of problems with which it is called upon to deal in the discharge of a new and more positive conception of government, and what changes, if any, are required to enable it the better to discharge those functions; secondly, the capacity of its personnel to handle those problems constructively, imaginatively and efficiently, with its corollary, the consideration of methods of the recruitment, training and tradition of the Service. It is not, of course, possible to separate questions of methods and men in practice quite so sharply. The personnel of a Civil Service may be defective because of lack of inherent capacity, but the presence of competent or incompetent officers in the Service and their subsequent attainments are determined largely by the methods of recruitment and training employed, just as the tradition of the Service has a large influence on its attractiveness as a career for the ablest minds and finest characters in the community it serves. Equally, it is true that no perfection of administrative methods and machinery will ensure efficient functioning unless the Service attracts administrative ability as well as integrity.

No serious criticism of the Civil Service, however, can ignore the fact that the extension of Government activities has come to stay; the social service State, the implementation of a policy of full employment, calling for a more positive conception of government, will impose fresh demands on the whole machinery of government as well as on the men to whom the actual work of government is entrusted. Leaving on one side the question of machinery, we have to ask ourselves, first, whether we are getting into the service of the State a sufficiently representative sample of the highest ability available, and then, having recruited from all possible quarters the right material, whether we are making the most effective use of that material.

These are the questions with which in the main Dr. E. N. Gladden is concerned in his recent book*; but his contribution is disappointingly small. He recognizes that the War marks a great change in the social structure of our world and that to-morrow's needs will require a new Civil Service for their fulfilment. But while he asks the question whether our present administrative machine is flexible enough to meet these new needs, and contributes an admirably lucid account of the evolution of the national administration and of recent criticism of the Civil Service as well as of its development in Great Britain, his analysis scarcely seems to go deep enough. He says the right things about official integrity and detachment, the method of open competition, and the like without being platitudinous. His review of recruitment is eminently sound, with its pertinent reminder that while the interviewing methods adopted

* The Civil Service: Its Problems and Future. By E. N. Gladden. Pp. 164. (London: P. S. King and Staples, Ltd., 1945.) 10s. 6d. net.

by the Civil Service Commission have been found satisfactory, it is doubtful whether the conditions of a short interview can have permitted a really high degree of objective accuracy to be attained.

Similarly, Dr. Gladden's review of training rightly emphasizes that normal methods of open competition pre-suppose a complete system of post-entry training; but while he admits that such training, especially that by encouragement, is largely absent, he gives little if any indication as to how this should be remedied. For a successful system, he points out, two changes would be essential: first, a new attitude by those in control; and, secondly, a Civil Service which would permit the advancement of the talented man more effectively than the present system. He criticizes the introduction of the training grade of the executive class as having too long a salary-scale and numbers too high in proportion to the higher grades of the class, and his discussion of promotion questions is likewise critical rather than constructive. It exposes the weaknesses in the assumptions upon which the use of a seniority list as the only basis of promotion rests, without indicating the measures which might be taken to increase the validity of those assumptions. Again, he points out that the qualities required for promotion, at least to supervisory posts, are not easily subjected to the examination process, and he recognizes the importance in a democracy of tapping the largest possible recruitment area.

Dr. Gladden's own proposals, to which the second part of the book is devoted, are designed to overcome some of these difficulties. The Civil Service organization must fulfil four requirements: it must be capable of meeting the functional aims for which it has been created; it must be synchronized at the recruitment stage with the school-leaving ages as prescribed by the different strata of the educational system; it must be able to meet the long-term changes postulated both by the alterations in the social environment and by the general development of administrative technique; and it must, while conforming to a centralized plan, be capable of meeting the various special demands of the separate departmental units. Briefly, Dr. Gladden proposes to secure this by constituting a new general clerical class to cover the present clerical-executive-departmental field, and by recruiting up to 50 per cent of the administrative class within the Service. The general clerical class would be divided into ten seniority or salary groups common to the whole Service, and for promotion purposes, group seniority would replace individual seniority. Recruitment from outside would be to the lowest three groups, the examination being cast on the present lines to obtain candidates from the primary plus stage, from the intermediate secondary stage and from the higher secondary stage. The scheme would provide for demotion, where necessary, for effective probation, and for transfers between Ministries to be arranged by a personnel organization board which would also control the staffing of new Ministries. A central training committee would be established and the study of public administration encouraged.

Without entering too deeply into the details of Dr. Gladden's proposals, and whether they are likely to secure all that he desires, it is clear that he recognizes the extent to which the chief problems of personnel organization reside in the management of the administrative rank and file, in the application of general rules to staff and in the selection therefrom of individuals for special tasks and positions. While his scheme may well ensure that the principles of objectivity in staff selection, both in recruitment and promotion, continue to be rigorously applied, it may be questioned whether they offer any real contribution towards the increase of flexibility of the Service where questions arise of taking into the sphere of government new institutions hitherto outside the State's orbit. Despite the wide range of his final chapter, with its clear recognition of the new and wider functions of government, of the necessity for new social incentives, the importance of individual efficiency and of the place both of expert and administrator in government—the only expert, he says pertinently, who bids fair to rule is the propagandist, without whose aid no dictator could rise to power, no government maintain its position, and no new programme gain the adherence of the crowd—Dr. Gladden is somewhat superficial. His conclusion that quite a modest measure of reform should suffice to fit the Civil Service to the superhuman tasks with which the nation's administration will be faced in the period of reconstruction is not altogether convincing.

Indeed, Dr. Gladden's book can be contrasted with a modest little study by Elizabeth Macadam*. Her brief review of the provision of training for the social services, to which Mr. S. W. Harris contributes a foreword, well illustrates the limitations of Dr. Gladden's book, although Miss Macadam is addressing herself specifically to a more limited problem, the importance of which was specially emphasized by Sir William Beveridge in his report on social insurance and allied services. The success of a social security policy will ultimately depend largely on efficient administration, and such administration in its turn depends not only on the efficiency of rank and file workers responsible for active work and personal contacts, but also on the quality of the numerically much smaller administrative staff responsible for direction and policy.

This aspect of the Civil Service has already attracted attention. It was ably discussed, for example, by Mrs. Joan S. Clarke in a chapter "The Staff Problem", contributed to the volume of essays entitled "Social Security" edited by Dr. W. A. Robson, and Mrs. Gertrude Williams has some pertinent observations in the final chapter of her study "The Price of Social Security". Mrs. Williams emphasizes the necessity of quantitative thinking by the administrator to supplement the principles of the use of powers conferred by law. For this, the Civil servant requires more knowledge of the workaday world, and the content of his mind as well as its quality is important. More and more it is required of the Civil Service administrator that he should be

* The Social Servant in the Making. By Elizabeth Macadam. Pp. 146. (London: George Allen and Unwin, Ltd., 1945.) 6s.

not only more competent to deal with situations as they arise, but also that he should know how to create the situation by looking ahead and preparing for it. Well may Miss Macadam observe, of objections to proposals to recruit older men and women to the administrative class, that something must be wrong with the machine of government if a few years work outside Whitehall makes a man too old at thirty to acquire a knowledge of its technique.

Miss Macadam, recognizing that social services have now no hard and fast boundaries, strongly supports the plea originally advanced by Sir Ernest Barker that the higher administrative posts of the Civil Services should be opened to a maturer type of candidate than those who successfully pass a competitive examination at an early age. This, in her opinion, is an essential step towards a modernized and socialized Civil Service, and the Government's proposals already announced in the White Paper on recruitment during the reconstruction period are a move in this direction. Next, she considers the university as the appropriate centre for training, and holds that every university should have its school of social study, though not necessarily the same equipment or identical aims. Schools in great cities, for example, will tend to become centres of instruction and research on a large scale. Oxford has opportunities for the study of rural conditions from its centre at Barnett House, while Manchester, Glasgow and Leeds should become centres for training in industrial personnel and welfare.

All this, of course, would implement the provision and admission of economists, sociologists, psychologists and statisticians, which has been emphasized by Mrs. Joan Clarke as so important now that constructive long-term thinking and exercise of the newer mental disciplines have become a government function of the first importance. Again, if organized courses for junior Civil servants on the lines of the staff college idea are established, Miss Macadam suggests that they would be better held at universities than concentrated at a special institution. The modern university is not so segregated that courses of study for public service on the lines laid down in the British Association Committee's report would fail to attract many different types of candidates or to offer opportunities for very varied contacts.

Some of these suggestions of Miss Macadam clearly deserve closer consideration in planning the post-war development of the universities of Britain. The establishment by the universities of sub-centres of social study in areas out of reach of a university is more a matter for inter-university discussion than for independent action, as is also the specialized development of social study schools ; while her reference to the need for a National Institute of Social Studies comparable with the Royal Institute of International Affairs points to a further problem in which co-operative planning will be required to avoid overlapping in research.

But there is a further reason for more deliberate planning and co-operation in this field. Unless the special fields of the social study schools of the universities are planned in co-operation in some such way, there is danger that the individual schools will not receive a sufficient regular supply of students. Moreover, as Miss Macadam again points out, while the content of mind is important, quality is important also, and we shall not attract the best type of entrant unless we open up wider possibilities of promotion in the Civil Services for those who qualify in this way. More sources of financial help during training are also needed ; but above all it is imperative to remove the deterrent of the relatively low salaries and limited opportunities of promotion at present available to those who enter the statutory social services. Nor should it be forgotten, as Miss Macadam reminds us, that this applies to the local government service also, where a socially trained administrative staff is equally important. Trained practitioners in the social sciences or in any other field of science may be ineffective if those under whom they serve have no conception of what social or scientific work means. There could be no more convincing demonstration of this than the difficulties which the proposals of the White Paper for a National Health Service have encountered through the well-founded distrust of the medical profession of local government administration. Had a sufficiency of administrators of the right outlook and training made their influence felt throughout that service, the whole reaction of the medical profession to the Government's scheme might have been fundamentally different.

Of the two books referred to above, Miss Macadam's appears to deal with the more fundamental issues in spite of its professedly narrower scope. She is more suggestive and her observations on the contribution of the university are a real contribution to the discussion of the place of the university in the modern world. Recognizing the grave danger of isolation in the teaching of particular aspects of social problems, especially those dealing with abnormalities and liable to fall completely out of focus when treated separately, she urges that university control provides a guarantee against the equally real danger of political or other forms of propaganda. The fact that social politics border so nearly on party politics is a strong reason why candidates for training should come under the influence of men and women who can be expected to preserve as impartial an attitude as possible. Both books draw freely on current reports and criticism of the Civil Service, though Miss Macadam's book might have been better documentated, and Dr. Gladden's select bibliography unfortunately omits reference to the British Science Guild's report. While they make little fresh contribution to the discussion, they nevertheless disclose the fundamental principles which must be followed in moulding the Civil Service in Britain to meet the needs of the future. The type of personnel required is already becoming clear. The traditional integrity of the Service must be maintained, and its members, from the highest grade to the lowest, must approach their tasks in the knowledge that they are indeed servants of the community. In addition, they must be imbued with a spirit of endeavour, and able to recognize the needs of the swiftly changing character of the world in which we live.

DISTRIBUTION PATTERNS

Maps for the National Plan

A Background to the Barlow Report, the Scott Report, the Beveridge Report. Prepared by the Association for Planning and Regional Reconstruction. Pp. iv+120. (London: Lund, Humphries and Co., Ltd., 1945.) 15s.

THE title, "Maps for the National Plan", may perhaps mislead purchasers of the work under review, for its anonymous compilers are members of a fact-finding group, and the maps in question do not present a plan, but have been chosen simply as furnishing in visual form a large collection of data deemed to be relevant to planning. In order to drive home their relevance, each map is faced by a column of verbatim extracts from the Barlow, Scott or Beveridge Reports, and these are usually well chosen, although the relation of catchment board boundaries to defective rural water supply seems a trifle tenuous.

The area covered is that of England, Wales and Scotland (excluding the Orkney and Shetland Islands), and all but one or two maps are gridded in accordance with the system adopted by the Ordnance Survey. On the key map entitled "Chief Urban Areas" the grid is ruled at 10-kilometre intervals, and this map is duplicated on a stout transparency, so that it can be laid over any other map in the series. It will prove rather a handicap to users that none of the counties, and very few of the towns, are named, which means that the maps must be used with an atlas. A second transparency, showing the "Distribution of Population" according to the Registrar-General's estimates for 1938, also loses much of its usefulness owing to the very unintelligent use made of the so-called 'dot method' of statistical mapping, one that has limitations which by now should be sufficiently well known. On a large number of the maps, however, the cartographical devices employed are undoubtedly fresh and effective, and the whole style of printing and production is at a very high level, especially by war-time standards. The method of binding, which certainly has the advantage that the maps lie perfectly flat, as well as the finished appearance of the maps themselves, is a reminder that a close scrutiny of a 'planner' usually reveals, not a lover of books or learning, but an architect or an engineer. Tribute has, however, been paid to the scholar's methods, for in an appendix the sources drawn upon for each map are carefully listed, and where necessary supplementary statistics and diagrams are supplied.

The analysis and interpretation of the maps is, however, left entirely to the reader, and this he may find difficult unless he is already accustomed to map techniques. Why, he will ask, could not the same information have been presented in literary form? The short answer to his question is this. Maps can reveal, as neither words nor figures can, whether or not a particular distribution shows 'pattern'. If the distribution, say of unemployment, is uniform or haphazard, it will show no pattern; if it is influenced either directly or indirectly by geographical location, it will. Maps such as these do away with the idea that industry, save for mining and shipbuilding, can 'go anywhere', and map techniques are now being employed in various Ministries to investigate this extremely complex problem of location. The basic pattern of any country is determined by its geological structure, which shows itself most clearly in the disposition of surface relief and drainage, soils and mineral resources. Surface relief and drainage in their turn underlie accessibility, while population aggregates, from villages up to conurbations, are usually found to be rooted in some combination of accessibility and resources, the latter including water supply and soil quality. Sir Halford Mackinder long ago pointed out the fundamental contrasts between the geologically older west and north-west of Britain, and the geologically younger east and south-east. The network of traffic links between the two, at its densest in the axial belt running from the metropolitan area to the Mersey, provides a zone of superior accessibility, the importance of which can be traced, now clearly, now dimly, through many of these maps. There is little doubt that the inaccessible location is the uneconomic location so far as industry is concerned, and also the undesirable location so far as a majority of gregarious mortals see it.

There is small warrant, therefore (security from air attack apart), for the widespread ruralization of industry which many planners desire to see. A map entitled "Country Towns Selected for Development", the only didactic one in this collection, should be examined in conjunction with the maps showing amenities and services, including, for example, the electric grid, medical men and secondary schools. The authority for this map is Mr. A. E. Smailes, whose published work (cited in relation to several other maps) is scarcely deep or searching enough to make him altogether a safe guide to follow.

It would be easy to find fault with these maps in detail: the economist would query this, the statistician that, the geographer something else. But looked at as a whole, the book is stimulating, and challenging. Here are matters which must be considered, which will be neglected at our peril. Who, for example, will be able to pass over lightly the pair of maps showing the proportion of the young to the old in 1911 and 1931 respectively? True that, by a perverse blindness to the importance of cartographical conventions, the areas proportionally richest in children in 1911 are shaded in deepest black; but in 1931 there are no such 'black spots'!

E. G. R. TAYLOR.

FOURIER AND TAYLOR SERIES

Lectures on the Theory of Functions

By Prof. J. E. Littlewood. Pp. viii+243. (London: Oxford University Press, 1944.) 17s. 6d. net.

THE material of these lectures is drawn from the most central and fundamental of recent developments in the general theory of functions of real and of complex variables. The introduction and Chapter 1 are already well known to the author's students, and will now be especially welcomed by a wider circle.

The introduction is mainly devoted to functions of a real variable and includes sections on inequalities, the analysis of function classes in relation to integration and generalized convergence, Fourier series, and harmonic functions of two variables; and gives in relatively few pages a remarkable amount of these extensive subjects. There is also a special study of some curious power series. Chapter 1 deals with the foundations of the maximum modulus principle and the convergence properties of sequences of analytic functions, but is mainly concerned with the theory of conformal representation of simply and multiply connected domains in a plane including the correspondence of the frontiers. Many accounts containing more or less the same subject-matter have been published; but the present one is notable for the great care which has been taken with the proofs and explanations of the subtle and difficult features with which the subject abounds.

The first volume ends with Chapter 2, which has been rewritten and extended with the collaboration of Dr. Rogosinski. This commences with a brief but substantial account of the theory of subharmonic functions, and for the rest is concerned with a special group of comparatively recent discoveries based on the notion of 'subordination'. In elementary calculus we are accustomed to argue from geometrical properties of the curve representing a function to properties of its derivatives or integrals and vice versa. The analogous process for differentiable functions of a complex variable is more elaborate because of the four-dimensional nature of the geometrical representation, and because the values of the function and its first derivative even at a single point influence their behaviour throughout their whole region of existence. This property (exhibiting power series and Fourier series in sharp contrast) is illustrated by a discussion of some of the simpler results related to Bloch's theorem. If, on the other hand, the values taken by the function are in any way limited, then its rate of growth at maximum, in the average, and in terms of its differential coefficients is correspondingly restricted. This consideration is developed in the "Lectures" for functions the values of which omit certain regions, curves, or isolated points, including in particular the author's own theorems on functions omitting a sequence of points and the proof of the Bieberbach conjecture in special cases.

The book possesses two very unusual features which overshadow the mere contents in importance and distinguish it from the more common compendium of (sometimes inadequate) quotations. One is the extreme care which has been taken over every detail of logic and presentation; and the other is the remarkable artistry with which so many different aspects are arranged in a logical and readable sequence. It is therefore unfortunate that bibliographical references of the customary standards have not been added on publication of the "Lectures".

A. J. MACINTYRE.

MODERN METEOROLOGY

Descriptive Meteorology

By Prof. Hurd C. Willett. Pp. viii+310. (New York: Academic Press, Inc., 1944.) 4 dollars.

WEATHER is still one of the major factors in war; air warfare especially has resulted in the intensive teaching of meteorology on an unprecedented scale. Teaching requires books, and the last few years have brought a number of excellent text-books, mostly from the United States, where lavishness in printing is still possible. The latest example, by Prof. H. C. Willett, maintains the high standard; it is excellently printed on good paper, well illustrated, and, more important, it is lucid, readable and completely modern. The arrangement follows the usual lines for a text-book of physical and dynamical meteorology (the title "descriptive" is over-modest); it begins with definitions, the composition of the atmosphere and the effects of vertical movements under adiabatic conditions. Chapter 3 deals with the heat balance of the atmosphere and includes a revision of the classic diagram due to W. H. Dines, which embodies the most recent data but is not quite so clear as its prototype. There are two striking vertical cross sections of the atmosphere over North America from 72° to 18° N., based entirely on *radiosondes*.

The next two chapters, on evaporation and condensation, and wind velocity, are on accustomed lines and do not call for comment, but the treatment of the general circulation in Chapter 6 is of great interest. The vertical cross-sections of temperature and pressure are used to reconstruct the zonal geostrophic winds above North America, but these diagrams are not clearly explained; moreover, they could profitably be supplemented by sections showing the variations of the observed winds with height. Charts of observed normal winds at 10,000 feet are given in a later chapter, but these afford only a very limited comparison. From these sections the author comes to the unorthodox conclusion that the variation of height of tropopause with latitude results from the dynamics of the general circulation and not from the strong heating of the tropics.

"Secondary circulations" include the rather odd grouping of monsoons and hurricanes. The account of the Asiatic monsoons is perhaps over-simplified; for example, the author implies that there are no rain-producing agencies in central China in winter, omitting mention of the storms associated with the passage of shallow continental depressions. The account of the development of a hurricane is excellent, especially the analysis of the conditions within the 'eye' of the storm.

The chapter on air-mass characteristics contains a good deal of new matter, including sub-categories for stable and unstable air based on thermal stratification at high levels, which make a useful extension of the earlier classifications. It is now recognized that "air masses which come from the same source region at the same season and by the same trajectory may differ greatly in their upper level stratification". The world charts of air-mass source regions are of great interest, but need to be studied in relation to maps of the prevailing winds. Unfortunately such maps do not appear anywhere in the book—a notable omission which ought to be remedied. Extra-tropical depressions, both surface and upper air, come under the heading of "secondary circulations of dynamic type", and along with much that is familiar, include a good deal of recent analysis of upper air conditions. "Tertiary circulations" embrace a miscellany of phenomena, from land and sea breezes to tornadoes; there is a new theory of the Föhn as primarily a change of air-mass rather than a result of dynamical warming. The book ends with a chapter on synoptic representation and a sketchy section on forecasting.

From this brief account it is evident that Prof. Willett has achieved something of a feat; at a time when meteorology is developing rapidly he has almost completely eliminated the usual lag between the publication of research in the scientific journals and its appearance in text-books. No doubt this is largely due to his own activities in one of the storm-centres of research.

C. E. P. BROOKS.

A Background of Physical Geography

By George P. Kellaway. Pp. viii+232. (London: Macmillan and Co., Ltd., 1945.) 8*s*. 6*d*.

THERE is need for more attention being given to the physical basis of geography in school work; too great attention to the human side, with neglect of the background, may encourage a subjective approach. This short volume is an attempt to supply the physical background for higher school and intermediate university geography.

The book covers a wide field with different degrees of emphasis. Broadly speaking, half of it deals with land features and the oceans, and half with the atmosphere. After the usual introductory matter on the earth as a planet, there follow a few notes, rather too brief, on theories regarding the earth's origin and kindred matters; Wegener's theory and isostasy, each in one page, are compression carried to excess. Of the chapters on land forms and land sculpture, the least satisfactory is that on islands, where some revision is required in the sections on volcanic islands and coral islands; Darwin's theory of reef growth is not the only one. The chapter on the oceans is short and comprehensive, but the author should note that icebergs are never formed from sea-water. The term is not used for sea-ice. Since the temperature and salinity of ocean water are discussed, it would be well to consider the bottom water and its origin.

The final chapters, on climate, are the best part of the book, though it is not clear to the reviewer why a discussion of climatic regions should be headed "Natural Regions of the Earth". Reliable information concerning the true polar regions is not so scanty as the author suggests, and is quite adequate for a clearer view of polar climates, both north and south, than is given here. It is high time that the old well-worn and misleading diagram of the planetary winds, as they would be on an ideal water-covered globe, was abandoned. The notes on vegetation, given for each major climate, should, for students of geography, be more explanatory and not merely descriptive.

The book is well illustrated, and on the whole may serve the purpose for which it is intended.

Introduction to Quantum Mechanics

By D. E. Blochintsev. (In Russian.) Pp. 484+79 plates. (Moscow and Leningrad: Unified State Publishing Co., 1944.) 18 roubles.

THIS modestly named volume is in fact a comprehensive treatise covering the whole subject of quantum mechanics. It summarizes the relevant basic discoveries of Planck, Compton, Einstein and Bohr in convenient mathematical form.

The chief sections are: basic principles of quantum theory; wave mechanics; relations between quantum mechanics, classical mechanics and optics; theory of movement of particles in a field of force; movement of charged particles in an electric field; theory of continuous spectra; radiation, absorption and dispersion of light by atomic systems; secondary quanta and quantum statics; magnetic phenomena.

A series of appendixes summarizes and clarifies the mathematical framework of the treatise. There is an adequate subject index. Bibliographical notes are interspersed as footnotes.

In spite of the poor-quality war-time paper, the volume is a dignified one. The printing of extremely complicated mathematical functions has been well done.

Five-Figure Logarithm Tables

Containing Logarithms of Numbers and Logarithms of Trigonometrical Functions with Argument in Degrees and Decimals. Pp. iii+188. (London: H.M. Stationery Office, 1944.) 7*s*. 6*d*. net.

THIS collection of five-figure tables has been compiled, as a war-time measure, to meet the ever-increasing demand, both in industry and elsewhere, for accurate numerical information of this kind.

The book is divided into three distinct parts. The first of these (occupying seventy-three pages) is a reproduction, from stereotype plates, of Chappell's table of logarithms, which gives five-figure logarithms of the numbers 10,000 to 40,000 and then those of 4,000 to 10,000 in that order. The second section is a photolithographic copy of von Rohr's table of five-figure logarithms of sines and tangents of small angles, over the range from 0° to 5°, for intervals of one thousandth of a degree in each case. Lastly there is a similar reproduction of Bremiker's table of five-figure logarithms of sines, tangents, cotangents and cosines of angles from 0° to 45°, for intervals of one hundredth of a degree in all cases. A table of constants is also appended.

Having regard to the urgent necessity for conserving paper supplies, it was considered unnecessary to provide a continuous pagination and the pagination of the three component tables has therefore been preserved unchanged. The original prefaces and explanations have also been omitted, and no instructions for the use of any of the tables have been supplied. The von Rohr and Bremiker tables have been reproduced with the authority of, and under licence from, the Custodian of Enemy Property.

It is worthy of note that the standard of reproduction and printing is very high.

J. H. PEARCE.

Gardener's Earth

An Introduction to the Study of Soils for the Everyday Gardener. By Dr. Stanley B. Whitehead. Pp. viii+231+24 plates. (London: J. M. Dent and Sons, Ltd., 1945.) 7*s*. 6*d*. net.

THIS is an interesting production, one of the better class of books on gardening written for the non-technical reader. Although it is mainly about soil, it covers a wider ground, including manures and fertilizers, pests and diseases and crops. In conformity with the title of the book, the discussion of these subjects is based on their soil aspects; this form of treatment has led to some repetition, both between and within chapters, that calls for pruning when a new edition is prepared.

In his discussions of soil moisture and cultivation, the author has fairly presented the results of modern research and technological investigations; in consequence, the alluring but inadequate picture of the soil pore-space as a bundle of capillary tubes finds no place in his exposition. The discussion of organic manures and artificial fertilizers is less happy. The non-technical reader may well wonder why the full (and excellent) account of artificials and their uses is included, in view of the blunt statements about them in the chapters on the virtues of organics; and it is a little unfortunate that the objective and scientific treatment maintained over the greater part of the book is occasionally obscured in these chapters. With these reservations the book can be given a welcome. A special word of praise is due for the excellent illustrations.

B. A. K.

PLANT PATHOLOGY: TEACHING AND RESEARCH*

By Prof. W. BROWN, F.R.S.

We are now, we hope, approaching the realization of peace and of that kind of atmosphere in which biological work, and more especially research, can hope to flourish once more. We have every reason for believing that the next few years will see many changes—changes in our educational system at all levels, with resultant effects upon students who take up an applied biological profession, and changes in our agriculture which will lead to a different emphasis upon instruction and research in biological subjects. With these changes impending, it may therefore be opportune at this time to look back over the years of one's experience, and see how far the old system appeared to be satisfactory and where on the other hand it did not give the results which might have been expected.

As the scope of plant pathology varies somewhat from place to place, it will be well, first of all, to say a few words on this topic. My own experience has been substantially in the region of mycological plant pathology, that is, I am a plant pathologist in the narrower sense which is current in Great Britain, as for example in the calendars of universities and agricultural colleges. This narrower definition leads to difficulties in practice, as for example in delimiting the respective spheres of the plant pathologist and the agricultural entomologist in the study of insect-borne diseases. It is much better, I think, to use the words 'plant pathology' in a wider sense, and to mean by it the study of the plant in disease, whatever the cause may happen to be.

On this topic of definition, I would venture to go even further towards generality. The word 'disease' has come to acquire rather a special meaning, and to most people implies more than mere 'unsatisfactoriness'. I would be prepared to stake a claim as follows. Wherever a plant (or a plant product) is unsatisfactory for any reason whatever and in any respect whatever, as for example when the yield has been smaller in quantity or less desirable in quality than might reasonably have been expected, there one sees a problem for the plant pathologist. No doubt it would be very easy to state problems which fall within this widest scope and which would sound curiously if labelled 'plant pathological'. Such matters appeal to me as details, and the important point is to recognize the unity of aim, which is to achieve more and more control over the plant in certain desired directions. The technicians employed must of necessity be various—entomologists, geneticists, mycologists, soil chemists and others—but they are all harnessed to the one major purpose, the production of more and better plants. I need scarcely add that this is the main interest of the public, who supply in the long run the funds which render our work possible.

I have put in my title the phrase: "Teaching and Research". The two are not easily separable, for there is general agreement that teaching will not long be very live if the research side is dead. The necessity for research in a teaching institution, quite apart from the desirability of keeping the name of the place upon the map, is all the more compelling if it is agreed that the object of teaching is not so much to inculcate a mass of facts which may soon be forgotten, as to instil methods of handling facts, and where possible of discovering new ones.

It would take too long to go into any detail as to what I think is the most desirable pre-graduation training for a man who intends to take up plant pathology as a career. The old system, or rather lack of system, under which we have been brought into the subject, can at least claim that it functioned in the best tradition of natural selection. But clearly one must set some limits to this sort of thing in the interests of efficiency and the saving of time. I would like to make some general observations under this heading.

First of all, what type of man, from the secondary schools, should we welcome as entrants into the biological field? Here I am giving my personal opinion, though I know that many of my colleagues are in agreement with me on this point. We must look here at the kind of training given in the schools.

There was a time, not so long ago, when botany was the only biological subject which found a place in the school curriculum. This applied only to a proportion of schools, and in these it was not on a level with the physical sciences. It was in general a subject for girls and for the weaker of the boys. In the ten years or so before the War there was a considerable change-over from botany to the composite subject biology. This movement was progressive and extended to schools which had not hitherto offered instruction in any biological subject. The expectation is that this development will continue after the War, so that we can look to a not-distant date when biology will take its place as a standard subject in schools, much on a level with physics or chemistry. Considered from the point of view of equipping the ordinary citizen for his life's work, this change has a great deal to recommend it, and I have not met anyone who seriously contests its merits. We are concerned here with the more limited question as to how it affects the equipment of students who go up to the universities bent upon a career in biology.

Frankly, I would say that we would rather that entrants into university biological departments did not have this preliminary biological training at school, and that for two reasons. One of these is probably temporary; the other, I fear, is permanent. As regards the first, we are still in the transition period, which may last for some time. For reasons which are sufficiently obvious, the standard of instruction at present reached varies very greatly from school to school, so that in the mixed batches who go up to the universities it is difficult to know where best we should begin. It is particularly with regard to laboratory instruction that we find the greatest unevenness, and obviously that is very important. No doubt this difficulty will lessen as times goes on. The second objection, of a more lasting nature, is this. Biological instruction in the schools has been developed at the expense of the physical sciences, and there is a grave risk that the biological student of the future will go up with an inferior grounding in these fundamental subjects. Once he has started on his biological work, he may never have the opportunity or the will-power to go back and make good the omission, and so the field of his usefulness may be permanently narrowed. Speaking broadly, one can say that there are some subjects of a kind that if one neglects them in one's

* Substance of the presidential address given before the Association of Applied Biologists on February 23.

youth, one does not easily pick them up later. Physics, and more especially mathematics, are such subjects.

Summarizing what I have just said, I would picture the desirable type of student somewhat as follows. It is immaterial whether he has had any biological instruction or not; but he should be well founded in the basal sciences, and also have a natural interest in plants or animals. *A priori*, I would rather that he were a countryman who preferred the country to the town, as he would be more likely to feel at home there and to have a broad country background.

The choice of training centre for such a student lies between the biological departments of a university, which nearly always is situated in a large town, and an agricultural college, which is usually in the country. Both have their merits and limitations.

Students at an agricultural college have the advantage that they are not brought up in a theoretical or academic atmosphere; they are in country surroundings and are in contact to some extent with the practical side of things. At the same time I am not prepared to allow that a few years' or even a lifetime's residence at an agricultural college necessarily imparts the true inwardness of the farming life. Many farmers draw a sharp distinction between what is done at an agricultural college and what they consider to be practicable on the average farm. From the technical point of view the great objection to the ordinary agricultural college as a place for the training of specialists in the plant industry is the meagreness of instruction in the basal sciences. A sound and comprehensive course in the biological sciences seems to me to be essential, and that is what the agricultural colleges are not at present in a position to give. Of course, one must allow for exceptional cases, and I know personally some excellent research workers who have graduated by this channel. Nevertheless I consider them to be exceptional cases.

The strength of the university department is the weakness of the agricultural college, and vice versa. I need not dilate upon the social advantages which accompany the university life; but shall confine myself to the technical. It is of the greatest value to a student, in his undergraduate years and perhaps more so during a period of postgraduate research, to be able to rub shoulders with workers in other scientific subjects or in university subjects generally, with consequent broadening of his outlook. There are also the special advantages of access to advanced courses on topics related to his main study, for example, courses on physical chemistry, spectroscopy, and so on. These advantages are obvious; the disadvantages require fuller treatment.

The question has been seriously asked: Is the rarefied atmosphere of a university biological department a suitable training ground for a man who is going to specialize in problems of plant culture? Prof. W. B. Brierley, in his presidential address of some ten years ago to the Association of Applied Biologists, discussed this point in a very lively manner and had much to say about the academic man sicklied o'er with the academic cast of thought. With much of what he said I find that I am in hearty agreement, though I am optimistic enough to believe that there has been an improvement in the interval. I do not think that you will find so many of the academic 'die-hards' flourishing in university circles as you would have found twenty years ago. It is also true that courses in botany and zoology are brought into line with current interests and activities, by the introduction of new and the scrapping of old material, though it may well be that the process of modernization is not going on fast enough.

Speaking in particular of botanical courses, I should say that the greatest weakness is the lack of intimate contact with growing plants. By intimate contact I do not mean merely looking at living plants; I mean actually handling them and growing them. It does not follow from this that I would like to train botanical students as gardeners or farmers, but I do hold that a training which deals largely with preserved plants and which is centred in a laboratory is lop-sided. Every effort should be made to bring the young student, from the earliest stage of his career, into contact with the practical growing of plants. This is desirable for all botanical students, but more especially for those who intend to take up an applied side such as plant pathology. Practical contacts can be developed by arranging for students to work at research institutes or on farms during vacation periods, and it is clearly desirable that the facilities in university departments for experimentation in the field or glasshouse should be extended. Granted that such facilities are forthcoming, I feel sure that the proper place for the pregraduate training of the plant specialist, including the plant pathologist, will continue to be the university biological department.

The field of research in plant pathology which is appropriate for a university staff (as contrasted with that of a research institute) is no doubt fairly wide; but there are some obvious limitations, even when the facilities of laboratory and experimental grounds are all that could be desired. The subject chosen should be one which could be expected to yield a result within a period of about two years, even though the primary object is not to obtain publishable results as such but to give training in research methods. Two years is a short time for outdoor research, where the kind of work possible is often dictated by the season, and especially when, as often happens, the first season must be largely given over to exploratory work and to the assembling of suitable material. A useful plan in my experience has been to assign to each student two problems, one involving laboratory work and often academic in outlook which could be followed up at any time of the year, and the other an outdoor one of a seasonal nature. This has a certain insurance value from the point of view of results, and is particularly useful in helping to tide the student over the earlier slack, and sometimes bleak, phases of the work.

Teaching and research of the kind which I have been describing, helped by my natural inclination in these matters, have had the effect of bringing me into somewhat close contact with the practical grower and his problems. It happens also that I come of farming stock and am personally acquainted with many farmers and their ways of looking at things. I may therefore be allowed to put down some of my reflexions on the functioning of the research machine, and these will fittingly conclude this address. As there will be some criticisms, I wish to make it clear that henceforth I shall be speaking of plant pathology in the narrow sense where my own experience lies and where I am surer of my ground.

First of all there is the much-debated question of the relative importance of academic and applied research, not merely from the point of view of research as such, but also of research as leading to results of practical value. It has always seemed to me that, in discussions on this topic, much confusion of thought has arisen from a more or less unconscious misuse of the rather numerous names which have been applied in this connexion. If we say that there are, broadly speaking, two types of research, the theoretical which aims at understanding phenomena without reference to any practical application of its findings, and the practical which aims at a definite practical result, there will, I think, be general agreement that both are important and desirable, and in many cases there will be found to be an interdependence between the two. Unfortunately it has been customary to apply a superfluity of names to each type of research, and the use of some of these names has led to misconceptions and, in my opinion, to some misdirection of research. Thus, the theoretical type is known as 'academic', 'fundamental', 'basal' or 'long-term', and the practical as 'applied', '*ad hoc*' or 'short-term'. I would like to comment upon some of these terms.

If by 'fundamental' is merely meant 'theoretical' as roughly defined above, I have no objections to it. There is, however, a strong tendency to read a further meaning into the word. Just as a house cannot be built unless its foundations or fundaments are properly laid, so, it is argued, must the practical work follow and rest upon the earlier fundamental investigation. One hears it freely stated that from such fundamental work results of practical importance drop out from time to time, and all that remains for the practical man is to recognize them as such or to seize upon certain principles, proceeding from which he can readily arrive at practical results. Now I am well aware that there is no great difficulty in furnishing examples in support of such views, more notably in certain physical arts—such as radiolocation—in which the practice has been built up upon results which a few years ago were of theoretical interest only. The relation of the biological sciences to agriculture is, however, somewhat different, as I need scarcely enlarge upon. Most of the results of practical value have been obtained by the growers themselves—sometimes by accident—and in such cases the function of agricultural science has been in the main to explain the results, to point out their limitations and sometimes to indicate improvements. It is well to recognize the fact that results of the very greatest practical importance have been obtained in connexion with problems the theoretical basis of which is quite unknown to this day. For example, it has been possible to breed potatoes which to all intents and purposes solve completely the problem of wart disease, and yet we are still quite ignorant of the theoretical basis of this very valuable result. Similar examples will no doubt occur to everyone.

It must not be thought that, in speaking as I have done, I am disparaging the theoretical type of research. I should be roundly accusing myself if I did so. It is obvious that theoretical research in biology generally, and in plant pathology in particular, has the same status as it has in any other science or form of learning—that it is worthy of being carried on, and carried on vigorously, on its own account. It has cultural value and adds its quota to the progress of civilization. It tends to fill in the general scientific picture, and from the point of view of the research worker himself it helps in many cases, if I may use the phrase, to keep his soul alive. It is, however, idle to maintain that practical results cannot be obtained without theoretical research, and it has always appeared to me that it is undignified, to use a mild term, to put forward as a justification of theoretical research the possibility that results of practical value may arise from it by accident. No doubt if pursued long enough and with sufficient insight, it may point the way to a solution of all our practical problems, but that date is not yet. The practical method, I feel, must still be to tackle the practical problem with the means at one's disposal, and in so far as difficulties arise to refer these back for closer investigation in the hope that new insight may be obtained. In other words, the practical method should be that of direct attack, with theoretical research harnessed to it for purposes of guidance and further development.

The description 'long-term' as applied to theoretical research is appropriate. I should be happy to see it replaced by 'everlasting', for the more successful a piece of theoretical research proves to be, the more does it suggest further problems. On the other hand, I heartily deplore the tendency to apply the word 'short-term' to applied research. I have no objection to the phrase '*ad hoc*', in so far as it means that there is a definite objective; but it is unfortunate that the adjective 'definite' is so often paraphrased to 'limited' and so to 'short-term', which in many cases has come to mean 'two years or thereabouts'—the normal duration of a research scholarship. The definiteness of an objective has no obvious relation to the time required to reach it, and in biological research, especially when its results are sharply conditioned by seasonal factors, it is surprising how long a time is necessary for the proper working out of even a simple problem. If, for example, it be the matter of the use of a fungicide, even when the best form of fungicide and the mode of its application have been settled, a great deal of work remains in testing its efficiency in various situations and over the variety of conditions which arise in a succession of seasons. I do not believe that the time-consuming nature of much applied biological research has been properly appreciated by those responsible for its organization, and to this more than to anything else is to be ascribed the fact that much research has failed to reach the farmer in a form usable by him. I shall refer to this point again.

The inadequate provision for the '*ad hoc*' type of research is illustrated in another way. Fundamental research, from its long-term nature, and because it gives no promise of early results, is not the kind of thing which the cultivator could be expected to subsidize. It must rely therefore upon official support, and examples of reasonable support for it are familiar to all. On the other hand, it has often been expected that for work of the '*ad hoc*' type the industry concerned should pay a substantial share of the cost. This would seem on the face of it to be a reasonable arrangement, and it has in fact functioned, but there are inherent difficulties. Perhaps I can illustrate this point by an experience of my own. When an investigation of the carnation wilt problem had been in progress for two years, support for its continuation was sought from the carnation growers. Very naturally the lead was taken by certain members whose nurseries were at the time being seriously ravaged by the disease. Others, however, were as yet untouched and therefore not so interested. It was freely hinted that the trouble might not be a bad thing in itself, as tending to prevent overproduction and to weed out the inferior growers. Later, it may be added, the disease spread to other nurseries so that some growers had to change their opinions. One grower said that he knew of a cure, and another that he did not propose to subscribe, but that he would pay for the cure when found. It so happened that there was present a man of very great importance in the industry who took the line that though his firm was not as yet seriously troubled by the disease, the industry as a whole was in danger, and it was highly desirable that he should have as much information as possible in advance of its coming. So the scheme came to be supported. I quote this example, not so much to illustrate how vexatious and chancy the initiation of research in this way may be, but to stress the fact that the financial interests of the growers of any one commodity are not necessarily identical.

Perhaps I should indicate here what, in my view, is the solution of this problem. The effect of the successful application of research to a problem of plant production is that the yield of produce of a certain quality is increased. This might lead either to a reduction in cost to the public, that is, to a raising of the standard of living, or to a reduction in the amount of land necessary for growing the required amount of produce, an economy which is obviously desirable in a small country such as Great Britain. In either event the advantage is national, and therefore the responsibility for initiating and supporting such *ad hoc* work should rest upon national funds, even though some growers may benefit, temporarily or permanently, from the results obtained.

I am hopeful that in the near future we shall see some improvements in the organization of plant pathological research. Hitherto, except for a few cultivations such as fruit, applied research has been of a very occasional and scattered nature. There has been little co-ordination, and, so far as I can see, a lack of purposefulness in following up the 'worth-while' problems to a stage where the results could be confidently brought to the notice of cultivators. It is the function of no one in particular to collate the work which has been done on a particular problem and to devise steps for carrying it forward to a practical solution. When such a survey is made, I am afraid that it will reveal a scarcity of practical methods of proved value, for the conditions under which much research has been done have been such as to limit its scope to purely mycological phases. I am not being facetious when I suggest that this state of affairs is reflected in the *abundance* of control measures which figure in plant pathological text-books. I am quite certain that many of the methods put forward are of doubtful practicability or usefulness, and that very few have been worked out in a manner which would convince a practical man.

The number of problems awaiting a practical solution is so great that a rigorous selection would be necessary to allow of adequate attention being paid to those deemed most important. What we require is a 'priority list' of problems, and when such a list is drawn up, I hope that the views of research workers and growers will be sought more freely than has been the case in the past.

The practical aim of plant pathological research is not to study plant disease as such, but to point the way to growing good plants in spite of a liability to disease. It seems obvious, therefore, that research should be organized on a crop basis. There must be research institutes for the main crop plants, with small and possibly movable field stations where the more local problems can be investigated on the spot. We have moved some distance in this direction and I think there will be a fuller development in the not distant future.

As regards the connecting link between research worker and grower, I speak mainly as a spectator. There is just one point which I wish to make in this connexion.

It has often been stated that research workers have in their possession a mass of information which the growers do not put to practical use, either because it is not brought to their notice at all, or if so, not in a form which they can understand. The blame for this tends to be laid upon the advisory organization. I would like to record what has been a frequent experience of mine when visiting nurseries in the Reading Province in company of the advisory mycologist. The object of the visit might relate to one particular problem, but by the time we had gone half-way round the nursery a dozen other queries had been put. There was obviously a multitude of problems, to many of which it was impossible to give a definite answer. Sometimes one could say that "Somebody in America had described a thing rather similar". The plain fact is that there are many growers' problems—of all kinds and dimensions—to which no clear answer can be given, because the necessary research work has not been done. This is a point which I have already stressed. Doubtless the advisory services could be made to function more efficiently—for example, by arranging better facilities for the demonstration of approved methods of culture —but I feel sure that, in the plant pathological field at least, the main lack is in the paucity of appropriate research, and not in the inability of the advisory services to convey such useful information as exists.

To sum up—there is no doubt as to the desirability and feasibility of tightening up our methods of training students for applied biological work, both in their undergraduate years and in their training as research workers ; but I feel certain that the greatest requirement is a well-directed concentration upon the problems which the practical grower is prepared to put before the scientific worker. There are many such, and if, as appears to be very likely, there is to be a continued intensification of agriculture in Great Britain, there will be many more in the future. There is no doubt, therefore, as to the magnitude of the field, and it is a responsibility devolving upon us, as scientific workers, to show that the practical problems of plant cultivation can be solved by the methodical application of the scientific method.

PSYCHOLOGICAL IMPLICATIONS OF THE CULTURE-PATTERN THEORY

AT the meeting of the British Psychological Society during April 5–10 in Exeter, a symposium was held on "Psychological Implications of the Culture.Pattern Theory". The speakers were Lieut.-Colonel R. F. Barbour, Dr. J. C. Flugel and Prof. T. H. Pear.

Prof. Pear opened by remarking that Ruth Benedict's "Patterns of Culture" was now ten years old ; it had affected some writers upon psychology who use the concept, but few attempts have been made to appraise the numerous psychological implications in the writings of Benedict, Margaret Mead, Bateson, Maslow and Clyde Kluckhohn in the

United States. Perhaps on this side of the Atlantic, C. H. Waddington's "The Scientific Attitude" and D. W. Brogan's "The English People" can also be regarded as offering, consciously or unconsciously, many examples of 'culture-patterns'.

The theory may help to reconcile certain conflicting opinions in sociology, ethnology, psychology and economics. It maintains that the customs, institutions and dogmas of a culture are woven into a more or less coherent 'pattern'. Every society utilizes only a certain selection of the motives to which men may respond and the goals towards which their behaviour may be directed. The particular selection that any one society employs may be said to give it its characteristic 'pattern'.

Of 'culture', Kluckhohn offers this working concept: "all those historically created designs for living, explicit and implicit, rational, irrational and non-rational, which exist at any given time as potential guides for the behaviour of man". Linton's distinction between explicit and implicit culture is useful here.

Explicit culture comprises "all features of a group design for living which might be described to an outsider by participants in the culture". It includes not only external objects but also manifestations of feeling and thought. An observer ignorant of cricket could describe its apparatus, as well as the fact that the interruption of an exciting innings by the tea-interval is taken for granted by English, and puzzles or infuriates American, spectators. Implicit culture is "that sector of which members of the group are unaware or minimally aware". An M.C.C. member might deem it unnecessary even to justify the tea-interval. Assumptions underlying the present ways of staffing the Foreign Office, or of granting army commissions fifty years ago, are unlikely to be stated easily by those who have always taken them for granted.

Kluckhohn defines two kinds of *patterns*, which he distinguishes from *configurations*. The *ideal pattern*, if described, conveys an idea of what, in a defined situation, people would do or say if they conformed completely to ideals accepted in the culture. For example, in stating the pattern "more than three persons waiting for a bus form a queue", the degree of deviation of actual cases of relevant behaviour from the ideal may not matter. But in a *behavioural pattern* attention is focused upon some mode of what people in fact do. The concepts are to some extent mutually dependent. Some criticism directed against Ruth Benedict's book is based upon the premise that she is writing about behavioural patterns. It is objected that she has not counted cases to establish statistical norms of behaviour, and has neglected material which does not fit her leading ideas. But, says Kluckhohn, "she is not so much interested in an inductive analysis of how the Zuni, for example, do behave in fact, as in suggesting a relationship between accepted standards of behaviour in Zuni (ideal pattern) and cultural configurations of which the Zuni are largely unconscious." A *configuration* is a concept of a higher order of abstraction than a pattern. Configurations are Sapir's "unconscious systems of meaning" and Benedict's "unconscious canons of choice".

A pattern is a generalization *of* behaviour or of ideals for behaviour. A configuration is a generalization *from* behaviour. Patterns are forms; configurations are interrelations between forms. A pattern can be defined by listing the parts in a determined sequence, and perhaps indicating the duration or accentuation of each (as in music). A configuration (as in music too) states the principle behind a group of patterns; it is implicit in them and must be inferred out. Into Benedict's scheme, says Kluckhohn, even ideal patterns enter less than do configurations. She comes nearer to dealing with the 'whyness' than the 'whatness' of a culture. When she designates both types of pattern and more than one type of configuration by the same term she invites confusion.

Illustrations of the above concepts were given by Prof. Pear. The Christian religion (Protestant and Catholic) shows behavioural patterns, ideal patterns and different, sometimes conflicting, configurations. The relative mildness of class enmity in England may be due to the fact that many important configurations, for example, 'fair play', respect for personalities, are common to different social strata and that others which are not, conflict less violently than in many other countries. He suggested that the culture-pattern theory, perhaps with these modifications, illuminates the following developments in psychology (among others).

Psychological provincialism. Some psychologists have tried to build up 'the science of behaviour of the normal adult' upon the basis of observations and experiments confined very largely to college students in Western cultures. Mass-observation and participant observation (functional penetration) have attempted to remedy this.

Some differences between psychological systems in the last fifty years may be due to the different culture patterns in which the authors grew up and lived. Examples given were James, Watson, McDougall, Freud, Jung and Adler.

The theory seems compatible with Prof. Gordon W. Allport's concepts of the transformation and functional autonomy of motives[1], put forward in his "Personality" and other publications.

Personality obviously depends upon culture pattern; and since there may always be with us the two opposed but complementary views of personality, one from the point of view of the 'actor', the other from that of the 'reactor', a study of culture-patterns will illuminate the way in which a judgment of a personality may cast at least as much light upon the judge as upon his 'subject'.

The difference between biological adaptation and mere temporary adjustment to the (often transient) claims of society is understood better by the help of this theory.

To what extent is the modern psychiatrist dependent upon the culture-pattern which 'employs' him? Must his tenets be fundamentally modified if it alters (for example, from a war-like to a peaceful set-up), or if he changes the country in which he works? To what extent does a psychiatrist on joining the combatant forces in any country accept the patterns and configurations of the new temporary 'culture'? How far do sentiments, ideals and purposes similar to those in the Allied armies actuate German army psychiatrists? Are their motives essentially different, and/or are they woven into a different 'pattern'? Would German army psychiatrists, for example, concur in certain English or American diagnoses of Hitler's mentality made *in absentia* and at a range of six hundred miles? To what extent are these diagnoses absolute or relative to certain postulated social norms?

Does a psychiatrist's own social, economic, religious, moral, political conditioning affect his attitude towards a psychoneurotic: (*a*) civilian, (*b*) soldier? Are some psychoses merely culturally defined, setting problems merely in social pathology? Are some psychoses constant all over the world?

May the success of the physical sciences have brought about a 'scientific attitude', which itself symbolizes a powerful culture-pattern? Is this in its turn now changing from respect for 'science' and its postulated 'freedom' (among educated people) to an overt opposition between this attitude, or sentiment, and one of doubt whether after two wars which men of science have made more deadly (perhaps made possible) the average individual scientific worker can any longer be blindly trusted to choose his problems? Nazi 'medical' investigators have betrayed humanity's trust in them: Can the ordinary man be blamed for reluctance to believe in the humanitarian bent of a man of science, merely because he calls himself by that name? (The broadcast discussion between Bertrand Russell and J. B. S. Haldane on May 4 (*Listener*, May 16, 1945) mirrors a clash of contemporary culture-pattern.)

Dr. J. C. Flugel pointed out that the distinctions between behavioural patterns, ideal patterns and configurations, though useful and important, are not clear-cut, and shade into one another. They all involve a greater amount of inferential supplementation than do perceptual *Gestalten*. As with the latter, we must beware of confusing the subjective pattern itself with the reality underlying it. There are two problems; one purely psychological: "How does the pattern arise in the observer's mind?" and one metaphysical: "How far does the apprehended pattern (usually no more than an interconnected set of 'generalizations') correspond to actual fact?" In the latter problem we are confronted with the same tasks as those connected with the validation, and interpretation when validated, of hypothetical 'types' or 'factors'. The doctrine of culture-patterns is made more difficult by the fact that, especially in complex societies, the various patterns that can be distinguished (of group, locality or time and of varying degrees of inclusiveness) have complicated interrelations. This may in practice greatly reduce the utility of 'patterns' as instruments of scientific thought.

Nevertheless the doctrine is valuable, as emphasizing social, contrasted with biological, explanations, as stressing the interrelations of the different elements of a culture, as producing useful working hypotheses and as raising many important problems (for example, its apparent opposition to the doctrine of 'archetypes'; to psycho-analytic interpretations of culture and to the whole trend of thought of the 'classical' school of Tylor, Frazer, etc., as well as to the assumptions underlying the more recent work of J. D. Unwin).

Lieut.-Colonel Barbour mentioned as a smaller but equally important problem, 'professional patterns'. Of the following he had had recent personal experience —boot operatives, hairdressers, psychiatrists. He asked whether psychologists tend to conform to some dynamic personal pattern. Is it easier for them to perceive the truth if it lies in one direction rather than in another? What is the bias of the observing, dissecting, enumerating mind?

Psychiatric diseases are still in the main defined in terms of inadequate performance of a human being *vis-à-vis* other human beings. In this War, psychiatrists when working as selection officers have developed a technique quite different from the clinical interview; where the medical man tends to be an inquiring, almost aggressive figure. In selection, he has to be more passive and receptive. He substitutes for the negative aim of discovering discords the positive one of evaluating all sides of the personality.

Being conscripted into the Services involves for most men and women what is tantamount to a change of culture, exchanging a personally determined, family-oriented existence for a regimented community life, lacking in privacy and comfort, with increased risks to health and life. He described how these changes of cultural environment affect the psychotics, the mental defectives, the psychopathic personalities, the psycho-somatics and the neurotics respectively. The battle incidents which precipitate many of the neuroses are horrifying only to our culture; but are a few phenomena, for example, the faint, symbolic of something more primitive, more remote?

Benedict stresses that culture need not be essentially repressive. Yet every society has its outcasts. It is culture which decides that a difference is a disability. In the last thirty years in England there has been a steady growth of the province of illness at the expense of that of ethics. Recidivism, sexual perversions, cowardice are now quite as likely to be looked on as evidence of illness as of criminality. It is a sign of the times—or of our culture—to send for the doctor or for the psychiatrist, where a generation ago the priest would have been called in. This is a change, possibly an advance, yet in another culture the teacher or politician might be consulted.

Lieut.-Colonel Barbour concluded: "It is particularly appropriate that this symposium should be held at this time. During the last twenty-five years we have seen the rise of Nazism and a new phase of national development in Russia. It makes me hopeful of this country, as we too can change our culture if we so wish. But we must scrutinize very carefully what appear to be some dominant trends of our time, among them the evading of individual responsibility, a softness of outlook which seems to expect life to be free, even of growing pains, a preference for compromise rather than for co-operation".

[1] Summarized in "Are There Human Instincts?" by T. H. Pear, *Bull John Rylands Library*, Manchester, 27, No. 1 (Dec. 1942).

X-RAYS AND CELLS

By DR. P. C. KOLLER
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THIS year marks the centenary of the birth of Roentgen, who announced the discovery of X-rays to the Physico-Medical Society of Würzburg fifty years ago (1895). The importance of X-rays for diagnosis in medicine was quickly realized; but their use in treatment, owing to technical difficulties, began only after the discovery of radium three years later. First radium was found to check the growth of tumours in mice[1], then X-rays were found to check mitosis in roots and pollen[2]; early discoveries, which form the remote foundation of modern radiotherapy, or radiation treatment. Later, Strangeways and his colleagues[3,4] showed that different doses had different kinds of effects on tissue cultures.

Yet while the evolution of radiotherapy was analytical on its physical side[5], on its biological side it remained empirical, for little or nothing was known of the way in which radiation exerted its influence on cells and tissues. To provide the required information many experiments have been and are being carried out on the 'biological effects of radiation'; a phrase which seems to claim too much for data which tell so little. Such diverse 'biological indicators' have been used as bacteria, infusoria, yeast and mould; fern and pondweed[6]; pollen, seed, root and stem of bean and onion; egg, sperm and larva of fly[7] and starfish[8]; toe and heart of frog[9]; caterpillars and salamander; sperm of ram; blood of mouse; eye of rat[10]; and skin of man; indeed, a regular witch's brew.

The dose varied as much as the material, from 2·5 to 200,000 r. The results varied even more, often to the despair of the experimenters. This confusion and contradiction of data can easily be explained, for most of the effects measured and compared are not the immediate and initial effects but the end-products of a chain of reactions set in motion by the radiation. The length and complexity of these chains are unknown. While the effects induced were striking, owing no doubt to the too high doses of radiation used, their complexity made an analysis of their origin extremely difficult if not impossible. From the many experiments on the biological effects of radiation two general conclusions were reached: that the effects were on the nucleus, and that their expression was delayed.

A new insight became possible with the discovery that radiation induces gene mutation[11] and breaks in the chromosomes[12]. Investigations by Muller[13] and others[14,15], using the sperm of *Drosophila*, showed the quantitative relationship between single ionizations in the chromosomes and the changes they induce. The analysis of the end-results of two such changes, seen as chromosome rearrangements, in the giant quarter-millimetre chromosomes of the salivary glands of *Drosophila* gave brilliant results[16]. But this success was limited by the fact that the structural changes were available for analysis only in the generation derived from X-rayed sperms, and these changes represent only a small fraction of those originally induced. Cytologists thereupon turned their attention to the direct study of X-rayed cells.

The advantage of their study is that the different changes in the chromosomes can be seen a few hours after treatment and the method of their origin can therefore be inferred. During the last eight years a great body of data has been obtained by Sax[17], Catcheside[18] and others using pollen-grains—single cells, which are also individuals with a fixed cycle of development. This new work confirmed the first principles established by Stadler[19] and Mather and Stone[20], that breakage and reunion were separate events and that breakages were of two orders—chromosome and chromatid—and the time the chromosomes split in the resting nucleus thereby established. Koller[21] showed that the death of the cell was the result not of direct action by X-rays but of loss of chromosome fragments at the ensuing mitosis. Again, however, it soon became evident that the interpretations of different workers were inconsistent. This could be attributed partly to differences in interpretation of the induced chromosome changes and partly to inherent shortcomings in experimental design. Most of the cytological analyses of the radiation-induced changes disregarded the enormous variation in breakability of chromosomes during the nuclear cycle and the great differences in rate of development of cells within any sample. Besides these two, lack of temperature control—which characterizes most cytological analyses—introduced a third error. Furthermore, the two most important events, breakage and reunion of broken chromosomes, although known to be separate events, have not been separated. The situation, indeed, sometimes showed signs of approaching insolvency, though concealed with higher mathematics.

A fresh approach to this problem is made by Darlington and La Cour[22] based on an analysis of spontaneous chromosome changes[23]. Their methods are new in several respects. Radiation effects are analysed in samples of complete cells in complete developmental series: root-tips, pollen grains and pollen tubes with resting stages lasting from a few hours up to 195 days. The breakage and reunion of chromosomes are recorded separately. Doses as low as 5 r. and up to 360 r. are used over a wide range of controlled temperatures. The statistical analysis, to which Mather has contributed, proceeds from frequencies to coefficients and correlations both new and unexpected. One simple example will show how these methods have brought order out of confusion. For many years it has been a moot point whether chromosome aberrations varied proportionately to, or according to some other power of, dose, and if the latter whether with a 1·5 power or with the square or with some other exponent. Now Darlington and La Cour have shown that breaks vary directly with dose, taking an average of total cell samples. Reunion of broken chromosome ends, on the other hand, varies with breakage, taking not whole cell samples but cells in classes with different numbers of breaks. One realizes, therefore, the hopelessness of the previous search for simple numerical formulæ.

These new methods of Darlington and La Cour seem to have been successful in separating the nuclear and cytoplasmic effects and in showing their interactions. The main conclusions reached are: (*a*) that breakability and rejoinability of the chromosomes are negatively correlated, (*b*) that variation in both depends on the activity of the cell and on the heterochromatic content of the nucleus. These correlations lead the authors to assume a common denominator in the three classes of effects: breakage, reunion, and sister reunion of chromosomes and chromatids. So much they seem to have proved; whether they are justified in supposing that this common denominator is the nucleic acid charge on the chromosomes further studies will show.

There is an interesting analogy between the primary effects of low-dose irradiation as described by Darlington and La Cour and the characteristic abnormal mitosis in tumours[24]. Both show a prophase hastened (not, as other workers have said, retarded); an excess of ribose nucleic acid in the cytoplasm[25]; and an excess of unpolymerized or sticky desoxyribose nucleic acid on the chromosomes[26].

Darlington and La Cour's results confirm some of the principles deduced from previous experiments. They seriously conflict with others for reasons which their new data make clear. They prove that irradiation, as well as temperature, affects the time-scale of development by which we have to measure its action in the breakage of chromosomes. This explains clearly why single-time comparisons of radiation effects (often with uncontrolled temperatures and incomplete recording) have hitherto shown discordant results. Their results show also the complexity of cell-response to radiation, which, however, can be revealed and analysed by the methods used.

Apart from the theoretical conclusions which Darlington and La Cour arrive at, their method of analysis (which they amply illustrate) will now enable us to investigate and to compare the effects of radiations of different wave-lengths (X- and gamma-rays, neutrons and alpha-particles), and that of different dosage-rates, all of which are of great importance in the development of radiotherapy. The misgiving has often been felt, and quite recently expressed in *Nature* by a physicist[27], "that there is an uncertainty about the action of X-rays which is very tantalizing. Complete success appears to be so near and yet continues to elude us". We now have, if not success, at least the prospect of success. The experiments of Darlington and La Cour give not only a new impetus to the study of the biological effects of radiation, but also a new foundation.

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THE BELGIAN NATIONAL FUND FOR SCIENTIFIC RESEARCH

By JEAN WILLEMS, C.B.E.
Director of the National Fund for Scientific Research

ON October 1, 1927, King Albert spoke on the occasion of the 110th anniversary of the creation of the Cockerill Works at Seraing, at the very centre of the industrial district of Liège. "Nations," he declared, "which neglect science and scientific men are marked for decadence. Considerable and sustained efforts must be made ; there must be more initiative if we wish—as we must wish—to maintain our position and our reputation. To-day, those who do not go forwards go backwards."

This speech was made less than ten years after the conclusion of the War of 1914–18, when the "Fondation Universitaire", as well as the funds of the various Belgian universities, had been richly endowed, following the winding up of the Commission for Relief in Belgium and of its Belgian counterpart, the "Comité National de Secours et d'Alimentation". It emphasizes the pressing demands made by science, and the continual expenditure which has to be faced for the maintenance of intellectual standards. King Albert's urgent appeal received a generous response, and three months later public subscription had provided Belgium with 115,000,000 francs. This led to the creation, on April 27, 1928, of the "National Fund for Scientific Research", which aimed at intensifying scientific activities, and at placing research workers and scientific men in such a position that they could play a worthy part in the moral and material development of the country.

The new institution benefited immediately from the active co-operation of the most eminent representatives of the academic world. Its programme of activities included all questions which had necessitated and justified its creation, and it soon appeared that the measures adopted justified the highest hopes. At first, however, the National Fund was scarcely known outside Belgium. It suddenly came to general notice when it assumed responsibility for a perilous venture which was eagerly followed all over the world. This was the first stratospheric ascent by Prof. Piccard. Within three days, this man of science achieved popular renown. Homage was paid to him at a scientific meeting, when Prof. Bordet, himself a Nobel prizewinner, said : "Your exploit, which has thrilled men of science, has gone straight to the heart of the people. They are filled with admiration when they see a man of your intellectual power champion the cause of science with the courage of a hero."

The National Fund was applauded for its share in this work, which proved its desire to promote actively international science.

This favourable impression was confirmed by the archæological excavations pursued at Apamea. One of the immense porticos which stood above the highway of this wealthy Syrian city, once a rival of Antioch, was partially reconstructed. Apamea was plundered and burned by the Persians in the seventh century B.C. ; but the discoveries made among its ruins have revealed original works of art and architecture, and particularly wonderful mosaics. These remains, now in the museums of Brussels, enable us to recapture some of the features of the ancient Persian and Roman town. The names of three Belgian historians and archæologists, Henri Pirenne, Franz Cumont and Fernand Mayence, are associated in this fine work.

Equally valuable results of another expedition supported by the National Fund are also gathered together in the Brussels Museums of Art and History. This expedition went to Easter Island, in the Pacific Ocean, and investigated the enormous statues carved in the rock, reaching heights of 6–30 ft., and weighing up to 40 tons. A Franco-Belgian mission, including M. Henri Lavachery, now keeper of the Royal Museums of Art and History, undertook the journey and succeeded in gathering valuable information on a most interesting problem. This was to discover whether the writing known by the natives of the island in the fourteenth or fifteenth century could be identified with that shown on slabs discovered in India, and dating as far back as 2,500 B.C. From this it was hoped to ascertain whether Easter Island was the remainder of a lost continent and of a rich civilization since vanished.

Another expedition sponsored by the National Fund was equally successful. Ruwenzori had first been seen by Stanley in 1888, and since then its eastern slope had been explored several times, the highest summits having been climbed for the first time in 1906 by the Duke of Abruzzi. But the western slope had remained unexplored. This part of the mountain lies within the boundary of the Belgian Congo, and the Belgian mission undertook to study methodically its geology, flora and fauna. Thanks to their skill and endurance, the expedition gathered much information, and hoisted the Belgian flag at an altitude of 15,000 ft.

About the same time other men tackled, with great devotion, a problem which combined scientific and humanitarian interests. For a long time, Belgian missionaries had pursued their work in certain parts of China. One of them, the Rev. Father Rutten, returned to that country accompanied by two medical men, and undertook long journeys to vaccinate missionaries. Their aim was first to check, in endemic conditions, the preventive methods advocated by Dr. Weigl, the Polish man of science, and secondly to test the curative value of a serum in cases of exanthematic typhus. The results obtained are well known: whereas in former years the Belgian community of Scheut lost a number of missionaries, no case of disease was recorded after vaccination, but the same mortality prevailed in the missions where vaccination had not taken place. These results were published by the French bacteriologist, Charles Nicolle, and by Prof. Bruynoghe, of the University of Louvain.

Belgium also took part in the organization of the International Polar Year (1932–33). Ever since 1882–83 the idea had been mooted of active co-operation of scientific workers belonging to various countries in order to bring more unity and co-ordination into the work of polar expeditions. The programme of the second Polar Year, prepared a long time ahead in the course of international conferences, included a great number of subjects: the meteorology and explorations of the atmosphere; the dynamics of cyclones and anti-cyclones; weather forecasts; terrestrial magnetism and atmospheric electricity; earth currents and the aurora polaris.

Under the auspices of the Government and of the National Fund, Belgium undertook to establish a new magnetic station in the province of Liège and another in the Belgian Congo. These stations carried on observations, following the plans elaborated by the Polar Year Commission. The president, Prof. La Cour, director of the Copenhagen Observatory, paid tribute on several occasions to the part played by Belgian scientific workers in the common effort.

A few other examples of the activities of the National Fund can only be mentioned: participation in the new scientific station established on the Jungfraujoch; in the work of the Commission of New Analytical Reactions and Reactives, created by the International Union of Chemistry; in the works of the International Office for the Protection of Nature.

Then came the War and the German occupation. The country was separated from the civilized world and endured with great courage and devotion the oppression and sufferings of this cruel ordeal. Her men of science and research workers resisted to the end. When one university was closed by the occupying Power, other universities and institutions received its professors and students. When one institution lacked some product or apparatus, other institutions gave them or lent them. When some professors or academic authorities were arrested or dismissed, their colleagues filled the gap. Without publicity, the National Fund applied itself to the task of helping promising young men of science and research workers, and of solving questions arising from war conditions, such as the scarcity of food, and the protection of the unique stained glass windows of the Church of St. Gudule in Brussels. It has also prepared the ground for attacking post-war problems, within the framework of its traditions. All this necessitated inroads on available resources, and great tenacity in spite of unfavourable and often hostile surroundings.

To-day Belgian scientific workers are once more free to speak and act according to their scientific conscience. Contacts have already been established with their foreign colleagues, publications have been exchanged, and visits abroad are being planned. The joy derived from this release can only be appreciated by those who have for years been 'in prison' in an occupied country. We are beginning to hear of the eminent part played by men of science during the War. They will work to-morrow with the same zeal to further the material and moral reconstruction of the world. The National Fund for Scientific Research will continue to support Belgium in the part she is going to play in this great work.

OBITUARIES

The Right Hon. the Earl of Onslow, P.C., G.B.E.

LORD ONSLOW died, after a long illness, on June 9 last. He was a man of many parts, many corresponding activities and many friends, who were attracted to him by his own native friendliness and the affectionate simplicity and sincerity of his disposition. His many public services, in the course of which he left his mark especially on the day-to-day administration of local government, are a matter of record. He rendered other services which are, perhaps, less widely recognized, though, regarded in their true perspective and in the light of the fruit they may be expected to bear hereafter, they may prove to be the most important of them all.

A sportsman, and, like most of that fraternity, a field-naturalist, Lord Onslow became, as a matter of course, a fellow of the Zoological Society, and, after many years of useful service on the Council, was elected president in 1936 as the obvious successor to the late Duke of Bedford. To this new task he brought the high sense of duty and the unflinching industry which characterized all his undertakings. He had, already, in 1926, been chosen as president of the Society for the Preservation of the Fauna of the Empire. In this post he was in his element, and it was here that he did what may well prove to have been the most enduring and most valuable work of all. To him the preservation of wild life meant the preservation of the beautiful and interesting things the contemplation of which above all makes human life worth living. He recognized as few others did that man, "a little lower than the angels", was also only a little higher than the rest of the world ecology of which he is a part, and incomplete if divorced from that ecology. Further, he recognized that, though man could destroy, and was, on balance, a destructive rather than a productive animal, he could not create. If man destroyed a species, it was lost for ever, and man might discover too late that he had done himself irremediable harm; and whether the damage done by the destruction of a species could be measured economically or not, at least, through his agency, life on this planet had been made less beautiful and less interesting, if not for everybody, at least for many of its human inhabitants.

It may well be that the first seeds of this conviction were sown in Lord Onslow during a period of his early life spent in New Zealand, where his father was Governor, and was one of the first to initiate practical measures to avert the destruction of New Zealand's unique avi-fauna. The indifference of New Zealanders to the marvellous ecology of which they became the trustees by right of settlement always distressed him. Having, as president of the Fauna Society, taken the leading part in securing the adoption of the convention for the Preservation of Wild Life in Africa, he turned eagerly to preparations for a new conference through which he hoped to extend the application of the principles embodied in it to south-east Asia and Australasia. That Conference was to have been held under his presidency in 1939, but the threat of a world war led to its postponement.

Throughout the War, he never lost hope of an active renewal of the campaign for wild-life preservation, which he hoped to see extended ultimately to the whole world. He watched with critical interest the negotiations of the Pan-American Conference in 1940 which led up to the convention for "Nature Protection and Wild Life Preservation in the Western Hemisphere" between the United States and the South American republics. He used unavailingly all the influence he possessed to induce the American States to invite representatives of Canada and other British and European-owned territories in the American Continent to the Conference, and was not a little exasperated by the illogical insularity which led the United States and the rest to exclude them. Nevertheless, he had the satisfaction of observing that the Convention agreed to follow in essentials the model of the African Convention of which he was the legitimate parent, and he was determined that American observers should be invited, for their better education, to the postponed Conference for south-east Asia and Australasia when summoned after the War. He was keenly interested, also, as was to be expected, in the movement for the establishment of national parks and nature reserves in Britain, and was a most active president of the Society for the Promotion of Nature Reserves.

It may be said of Lord Onslow that he saw the light and, very clearly, the vision which the light revealed. In failing health he never lost interest in the work of the Society for the Preservation of Fauna of the Empire, and probably few events gave him greater pleasure than the presentation to him in November last of the first gold medal of the Society in recognition of his outstanding services to the cause of fauna conservation. It will not be easy to find a torch-bearer to succeed him, one who will feed the flame as he fed it, and bear it blazing bright with the same resolute and lofty inspiration.

HENRY G. MAURICE.

Dr. Hans Przibram

THE obituary column of *The Times* records the death "some time in 1944, at Terezin (Theresienstadt), Czechoslovakia, of Hans Przibram, formerly Professor in the University of Vienna, and his wife Elizabeth Margarethe (*née* Ruhmann)". Behind these words lies untold tragedy; for Theresienstadt was one of the worst of the concentration camps, and many thousands of Jews were slaughtered there. The War had not long begun when we heard of the death at Dachau of Prof. M. Siedlecki of Cracow, an old and famous and much-loved naturalist; it is scarcely ended when we hear that Hans Przibram has been done to death, who once was rich, enthusiastic, hospitable, and whose Laboratory, or "Vivarium", was known to every naturalist who came to Vienna. We know of many another, and dread to hear of more, who have suffered from the same ferocious inhumanity.

Hans Przibram began his work about forty years ago, under the influence of Wilhelm Roux, Jacques Loeb and Hans Driesch; in other words, he became a student of experimental zoology. He planned an ambitious work under that title, and brought it out between 1907 and 1914, in five parts, on "Embryogenese", "Regeneration", "Phylogenese", "Vitalität" and "Function". An early paper of his, on the "Anwendung elementärer Mathematik auf biologische Probleme", appeared in *Roux's Vorträge* in 1908; and fifteen years later he published an "Aufbau mathematischer Biologie", in *Shaxel's Abhandlungen*. Another book of his, published in 1922 after he had become *ausserordentlich* professor of experimental zoology, was entitled "Form und Formel im Tierreiche", or "Beiträge zu einer quantitativen Biologie". It contains many useful numerical data, physiological and morphological, or "biological constants" as he chose to call them. The new science of biometry was after his own heart, and he published various "Messungen und Wachstumsmessungen", chiefly among insects. These measurements, especially those on one of the praying mantids, led him to believe (as Brooks and others had suggested before) that the spurts of growth and successive moults of an insect tended to coincide with a doubling of its weight and (presumably) with a histological duplication of every cell in its body; and further, that the doubling of its weight implied a linear increase from one stage to another in the ratio of $1 : \sqrt[3]{2}$, or $1 : 1{\cdot}26$. The sizes of the successive chambers in a spiral foraminifer should, and do (he said), follow the same law; but the study of the cast skins, or successive moults, of a serpent led to no such result, for no general histological duplication was involved. There was a good deal of truth in all this; but Przibram was apt to go too far, and let his theories outstrip his facts. It is at least clear that he was a keen and early student of that experimental side of zoology which has proved engrossing ever since to many.

Hans had a brother Karl, a distinguished physicist; we have no news of him. He wrote, among other papers, some on the Brownian movement, which I remember attracting Sir J. J. Thomson's attention to when they appeared. One was on the Brownian movement of non-spherical bodies, and another (in *Pflügers Archiv*) on the Brownian movement as indicated in the movements of minute organisms. He also wrote a curious paper on "Form und Geschwindigkeit: ein Beitrag zur allgemeine Biologie".

D'ARCY W. THOMPSON.

WE regret to announce the death of Lord Exmouth, who during 1897–1911 was a member of the chemical staff at Columbia University, on June 7, aged eighty-two.

NEWS and VIEWS

Award of Bruce Medal to Prof. E. A. Milne

THE Bruce Gold Medal, founded in 1897, is unique among astronomical awards in that the responsibility for the nomination of candidates rests with the directors of the Harvard, Lick and Yerkes Observatories in, and the Greenwich and Cordoba Observatories outside, the United States. The consequence has been that the directors of the Astronomical Society of the Pacific, who are the trustees of the Bruce Medal Fund, have always had before them the names of the outstanding astronomers of the time, and so wise has their final choice always been that the Medal is generally recognized as the highest award for astronomical achievement. It is only fitting that the name of Edward Arthur Milne should be added to those of the great mathematical astronomers—Newcomb, Hill, Poincaré, E. W. Brown, Eddington, de Sitter and Charlier—who have achieved this distinction. Milne's contributions have covered a wide field in astrophysics and cosmogony. His studies of radiative equilibrium in stellar atmospheres greatly extended and deepened the classical results of Schwarzschild in this field, while the collaboration of Milne and Fowler in the application of ionization theory led to the generally accepted scale of temperatures and pressures in the stellar sequence. By-products of these two main lines of investigation were a theory of the equilibrium of the solar chromosphere as a result of monochromatic radiation pressure, and the concept of 'run-away atoms' as the carriers of those disturbances in the sun which lead to terrestrial magnetic storms and radio fade-outs.

Milne's recent work has traversed more controversial ground. On one hand, he has dealt with the consequences which flow from the role of photospheric opacity on the internal structure of the stars; and on the other hand with the kinematic aspect of the apparent recession of the extra-galactic nebulæ, treated in the first instance as actual motions in a flat Euclidean space. The attempt to introduce dynamics and gravitation into this concept of world structure has led to the distinction between the finite t-time by which the observer on a 'fundamental particle' describes events, and the τ-time with an infinite past with which events may be described in a public hyperbolic space. No matter what the ultimate success of these later ventures, there can be no doubt of the clarification in our ideas which has already resulted from his work, or of the courage which this single-handed attack upon these great problems must have demanded. The award of the Bruce Medal is therefore but a fitting recognition of Prof. Milne's great contributions to our knowledge of the stars, and of that larger system of which the stars form a part.

Guthrie Lecture of the Physical Society: Prof. Arturo Duperier

THE Guthrie Lecture of the Physical Society will this year be given by Prof. Arturo Duperier on July 6 at the Royal Institution, his subject being "The Geophysical Aspect of Cosmic Rays". As research professor in the Instituto Nacional de Fisica y Quimica (Rockefeller Foundation), Madrid, Dr. Duperier made experimental studies in magnetism in association with his former teacher, Prof. Cabrera. Later, in 1932, he was appointed professor of geophysics at the University of Madrid. His geophysical researches included studies on meteorology, atmospheric electricity and cosmic radiation; papers on these subjects were published during the Civil War, in the course of which he paid two visits to Great Britain; the victory of Franco occurred during his second visit, and he has since lived and worked here. In association with Prof. P. M. S. Blackett he continued observational work on cosmic rays at Manchester, with the aid of a research grant from the Royal Society; later he transferred his apparatus to the Physics Department of the Imperial College, London, where he has worked for several years. His observational discoveries include remarkable occasional changes of cosmic-ray intensity associated with geomagnetic storms.

British Coal Utilisation Research Association: Prof. D. T. A. Townend

PROF. D. T. A. TOWNEND, Livesey professor of coal, gas and fuel industries at the University of Leeds, has been appointed director of the British Coal Utilisation Research Association. Educated at Bancrofts School, Prof. Townend held an exhibition at the East London (now Queen Mary) College, where, after war service, he graduated in 1920. Following post-graduate study in fuel and chemical engineering at the Imperial College of Science and Technology, he was associated there for many years with the late Prof. W. A. Bone and Prof. D. M. Newitt in investigations into combustion and high-pressure problems; and held successively a Salters research fellowship and a Rockefeller international research fellowship. He is a leading author in the field of combustion, and in 1933 discovered the two-stage ignition phenomenon of higher hydrocarbons, etc. The Livesey chair which Prof. Townend has occupied for seven years was endowed by the gas industry in 1910, since when the Department has collaborated closely in research with this industry. Prof. Townend has served on the Council of the Gas Research Board since its inception in 1939 and is an honorary member of the Institution of Gas Engineers; he is also chairman of the Yorkshire Section of the Institute of Fuel. During the War he has served on a number of Government committees and his Department has made notable contributions to the war effort.

Visit of Prof. A. V. Hill to Denmark and Norway

PROF. A. V. HILL, senior secretary of the Royal Society, is visiting Copenhagen to convey the greetings of the Royal Society, as representing the men of science of Great Britain, to their colleagues in Denmark; and through the Academy of Sciences in that country to discuss with them what aid British science can give to the rehabilitation of science and scientific education in their country. After three days in Copenhagen, Prof. Hill will proceed to Oslo for the same purpose. An extraordinary meeting of the Norwegian Academy of Sciences has been called to meet him. It is hoped that these visits will do much to enable both the Danes and Norwegians to re-establish the firm scientific contacts which, until the occupation of their countries by the Nazis, they have always maintained with men of science throughout the world.

Destruction of Scientific Institutes in the Philippines

INFORMATION has been received that the buildings of the Bureau of Science, Manila, have been utterly destroyed in the fighting for that city; and, moreover, it is reported that the Japanese have destroyed the Philippine College of Agriculture at Los Banos, eastward of Manila. The loss of the scientific collections and libraries in the Bureau of Science is irreparable. The Bureau took shape in January 1906 by the union of the Bureaux of Government Laboratories and Mines, and was charged with investigations in bacteriology, immunity, prophylaxis, etiology, botany, various branches of zoology (in particular entomology), technological chemistry, geology and mining engineering. The whole structure has gone—the records of the work of forty years; for the two Bureaux named had been at work for four years before the Bureau of Science was formed.

Botany has been singularly hard hit and singularly ill-fated in the Philippines. The collections which Sebastian Vidal made when he was inspector of forests towards the end of the Spanish regime were lost in an accidental fire in 1897, and those of the Augustinian Friars burned when the Guadalupe Monastery was destroyed in the fighting in 1899; in consequence of this, Dr. E. D. Merrill, who went to Manila in 1902 as Government botanist, had to begin his work without foundations on the spot. He gathered together a herbarium unique in its facilities for study of Philippine botany and a botanical library second to none in Asia. These have gone. His four-volumed "Enumeration of Philippine Flowering Plants" (1922–26) preserves a part of the records; but beyond collections from the islands, the herbarium held a great amount of comparable material from all parts of the East.

Spectroscopically Standardized Substances

As the use of the spectrograph for the detection and determination of the metallic elements in all kinds of materials increased, there arose a demand for extremely pure metals, oxides and salts to serve as standards. About 1922 Dr. S. Judd Lewis suggested to Messrs. Adam Hilger, Ltd., that they should supply for this purpose spectroscopically standardized substances; the proposal was adopted, all arrangements for the supply of the substances and their analysis being in the hands of Dr. Judd Lewis. These pure substances have become well known under the trade mark of "H. S." Substances, and now include most of the more common and many of the rarer metals, as well as most of the rare earth oxides. In 1932, when Dr. Judd Lewis proposed the 'ratio quantitative' method of spectrographic analysis, the 'Specpure' series of 'ratio powders', 'ratio solutions' and pure salts was introduced, and now comprises more than fifty substances which are available in a spectrographically standardized condition. Every supply of "H. S." or "Specpure" material has always been accompanied by a full report of the results of chemical and spectrographic examinations made on that material. So far as possible, an estimate is given of the amounts of each trace element present, and reference is made to all the spectrum lines due to the impurities which have been detected.

In view of the ever-increasing demands for the substances included in these two schemes and for new additions to the list, the need arose for additional manufacturing and analytical facilities. Messrs. Adam Hilger, Ltd., have therefore entered into an agreement with Messrs. Johnson, Matthey and Co., Ltd., whereby the latter will in future undertake the supply of these substances and the control of their purity at their Research Laboratories, Wembley, Middlesex, where many of them will be made. Dr. Judd Lewis, who acted as consultant for Adam Hilger, Ltd., for many years and was chiefly responsible for the development of the "H. S." and "Specpure" schemes, has been engaged in that capacity by Messrs. Johnson, Matthey and Co., Ltd., and the staff of the Spectrographic Department of their Laboratories has been augmented by the appointment of Mr. D. M. Smith, formerly in charge of spectrographic investigations at the British Non-Ferrous Metals Research Association. Future sales of "H. S." and "Specpure" substances will be made only by Messrs. Johnson, Matthey and Co., Ltd., from their head office at 73–83 Hatton Garden, London, E.C.1.

Official Topographic Maps

OFFICIAL large-scale maps are available for comparatively few parts of the world outside western and central Europe, including the British Isles, the eastern United States, India, much of Burma, several of the Netherlands East Indies and Japan. South America, Africa and Australia each have few areas of such detailed survey. In the April number of the *Geographical Review*, a coloured world map on a scale of 1 to 50,000,000 compiled by R. R. Platt shows the distribution of official topographic maps as available at the outbreak of war in 1939. It covers scales up to and including 1 : 253,440 (4 miles to 1 in.). Three categories are recognized, scales of 1 mile to 1 in. or larger, those of 1–2 miles to 1 in. and those of less than 2 miles down to 4 miles. Under each category an attempt has been made to distinguish between maps based on topographic survey on which relief is shown by contours or hachures, and maps of less complete detail with relief shown by form lines or hill shading. As a general rule, only maps produced by States for their own territory are shown, but there are some few exceptions. Compilations produced by an official agency of one country in the territory of another are not shown.

Russian Papers on Pure and Applied Mathematics

AMONG Russian periodicals and books recently received are several containing papers on pure and applied mathematics. A striking feature is the many investigations of elasticity problems in *Applied Mathematics and Mechanics*. There are also many other papers of considerable interest, for example, the paper on the flow of a gas at supersonic velocities by V. S. Tatarenchik (*App. Maths. and Mechanics*, 8, 401; 1943), which should be compared with current investigations by Southwell and his colleagues (*Nature*, **154**, 90 and 834; 1944). N. N. Parijsky gives (*Astron. J. S. U.*, 21, 78; 1944) the result of calculations which support Russell's criticism of Jeans' theory of the origin of the solar system. In addition to the journals mentioned above, we have also received a valuable atlas of nomograms, containing thirty-seven plates. All the publications received are being deposited in the Science Museum, South Kensington, London, S.W.7, where they will be available for anyone who desires to consult them. By the aid of the summaries in English or French, it should be fairly easy for those entirely ignorant of Russian to understand the results and methods of the papers.

Belgian Visitors to Britain

THE fourth group of distinguished Belgians to visit Great Britain as representatives of the Belgian Fondation Universitaire and guests of the British Council have arrived in London. They are: Prof. M. Florkin, Faculty of Science and Medicine, Liège; Prof. F. Albert, Faculty of Medicine, University of Liège; Prof. F. Bremer, Faculty of Medicine, University of Brussels; Prof. A. Castille, Faculty of Medicine, Louvain; Prof. J. C. Firket, Faculty of Medicine, Liège; Prof. H. R. Fredericq, Faculty of Medicine, Liège; M. Jean Willems, director of the National Fund for Scientific Research (see p. 780); and Prof. L. M. Gyselynck, Faculty of Law, Brussels. They are meeting leading British authorities in their particular spheres in universities and research institutions in London, Cambridge, Oxford, Liverpool, Edinburgh, Glasgow and Belfast.

University of London

PROF. D. HUGHES PARRY, University professor of English law at the London School of Economics and a member of the Senate since 1930, has been elected vice-chancellor for the year 1945–46.

The title of professor emeritus has been conferred on the following: Prof. Major Greenwood, professor of epidemiology and vital statistics since 1926; Prof. William Wilson, Hildred Carlile professor of physics at Bedford College from 1921 until his retirement in 1944; Prof. Harold Simpson, professor of mathematics at Bedford College from 1912 until his retirement in 1944.

Prof. C. Daryll Forde, since 1930 Gregynog professor of geography and anthropology at University College, Aberystwyth, has been appointed to the University chair of anthropology tenable at University College as from October 1, 1945.

The degree of D.Sc. has been conferred on Dr. E. T. Davies (Birkbeck College), Dr. F. W. Jane (Birkbeck College), Mr. S. G. Soal (Queen Mary College), Mr. A. C. Frazer (St. Mary's Hospital Medical School), Mr. L. A. Allen and Mr. C. G. Johnson.

Summer School in Colloid Science

THE Birmingham and Midlands Section of the Royal Institute of Chemistry has arranged, in co-operation with the Departments of Colloid Science and Physical Chemistry of the University of Cambridge, a Summer School in Colloid Science in the form of two courses, extending from June 23 to June 30 and June 30 to July 7 respectively. The director of tuition for the School is Dr. A. E. Alexander. Both courses are being opened by Prof. E. K. Rideal, professor of colloid science in the University of Cambridge and president of the Society of Chemical Industry, and the opening lectures are by Dr. W. Clayton, on "Foods as Colloid Systems" (course *A*), and Dr. E. H. Callow, on "Colloids in Theory and Practice" (course *B*). Some two hundred research chemists are attending the School.

The Night Sky in July

NEW moon occurs on July 9d. 13h. 35m., U.T., and full moon on July 25d. 02h. 25m. The following conjunctions with the moon take place: July 5d. 06h., Mars 3° N.; July 6d. 02h., Venus 0·4° N.; July 11d. 10h., Mercury 2° S.; July 14d. 12h., Jupiter 4° S. Only one occultation takes place in July, 20 Ceti reappearing on July 30d. 00h. 37·7m.; the time refers to the latitude of Greenwich. Mercury sets at 21h. 26m., and 20h. 22m. at the beginning and end of the month respectively, attaining its greatest easterly elongation on July 23, and is not very well placed for observation during the month. Venus is a conspicuous object in the early morning hours, rising at 1h. 30m. and 1h. 08m. at the beginning and end of the month respectively. Mars moves from the constellation of Aries into Taurus during July and rises at 0h. 53m. on July 1 and 23h. 18m. on July 31. Jupiter sets at 23h. 15m. at the beginning of the month and at 21h. 27m. on July 31, about an hour and a half after sunset, and is not easily observed. Saturn sets about quarter of an hour before the sun on July 1 and is not favourably placed for observation. The earth is at aphelion on July 5.

A total eclipse of the sun takes place on July 9, partly visible as a partial eclipse at Greenwich, where the eclipse begins at 12h. 45m. and ends at 15h. 11m. The magnitude of the eclipse at Greenwich is 0·61. The central line commences in long. 115° 57′ W. and lat. 44° 23′ N., and ends in long. 72° 33′ E., and lat. 41° 43′ N.

Announcements

PROF. ARNOLD N. SHIMMIN, now acting professor of industrial relations in the University of Leeds, has been appointed to the newly instituted chair of social science in the Department of Economics of the University.

DR. KATHLEEN LONSDALE has been appointed by the managers of the Royal Institution to be Dewar Research Fellow in succession to Dr. A. R. Ubbelohde.

THE Committee of Privy Council for the Organisation and Development of Agricultural Research has appointed Prof. T. G. B. Osborn, Dr. J. L. Simonsen, and Mr. W. J. Wright as members of the Agricultural Research Council in succession to Prof. E. J. Salisbury, Sir Robert Robertson and Sir Robert Greig, whose terms of office as members of the Council have expired.

THE Library of the Chemical Society is now remaining open for longer hours; it is open from 10 a.m. to 6 p.m. on Mondays to Fridays and 10 a.m. to 5 p.m. on Saturdays.

THE fifth number of the *Revue d'Alger* published by the University of Algiers includes an interpretation of the American constitution, under the title "The Function of the President of the United States", by A. Heekscher, an article by G. Darmois on "The Tercentenary of the Birth of Newton with an Appreciation of his Work"; and one by J. Malmejac and S. Cruck on "Penicillin: History of a Recent Discovery in Medical Therapy". G. Cohen contributes a note on the Free School of High Studies at New York, urging the creation in Paris of a similar school for American students living in France, and M. Koch a survey of the French Rhine and its economic and imperial role.

ERRATUM.—In his communication on "Calculation of the Results of Microbiological Assays" in *Nature* of May 26, Mr. Eric C. Woods states that on p. 633, line 11, "2 μgm." should read "0·1 μgm.".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Night-Sky Emission and Region *F* Ionization

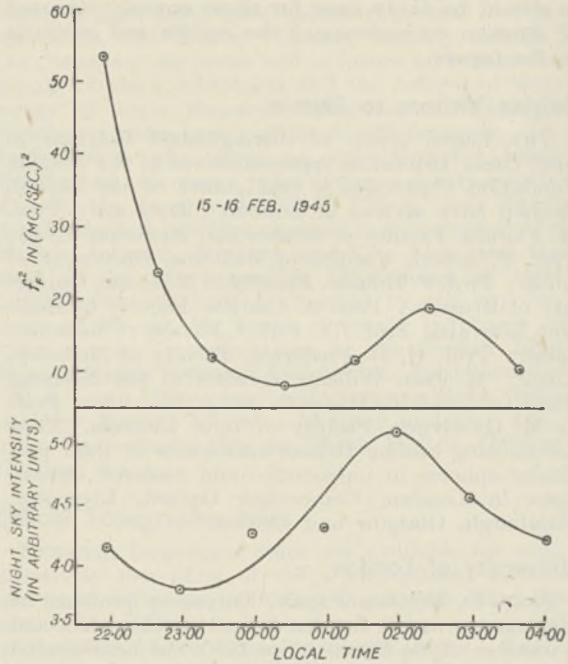
IN the theory of emission of the night-sky spectrum recently proposed by me, the Region *F* of the ionosphere is identified as the luminescent layer[1]. The characteristic night-sky spectrum in the visible region consisting of the first-positive and the Vegard-Kaplan bands of N_2 and the auroral green and red lines of O are supposed to be emitted by the following reaction :

$$N_2^+ + O^- \rightarrow N_2 \text{ (excited)} + O \text{ (excited)}.$$

The energy released in the process of neutralization by electron transfer is given by the ionization potential of N_2 (15·58 eV.) less the electron affinity of O (2·2 eV.). This energy is taken up almost entirely as energy of excitation of N_2 to the $B^3\pi$ state ($v' = 9$; 9·1 eV.) and of O to the ^1S state (4·2 eV.). (There is some uncertainty about the value of the electron affinity of O. While Lozier[2] gives the value as 2·2 eV., recent experiments of Vier and Mayer[3] yield the value 3·0 eV. But even with the latter value there is sufficient energy available for raising N_2 to a high vibrational level of $B^3\pi$, if account is taken of the kinetic energy of the colliding particles.) According to the theory therefore one would expect a positive correlation between variation of the night-sky intensity and variation of the electron content of Region *F*. Prolonged observations on the intensity of night-sky emission and on the Region *F* ionization density (square of penetration frequency f_F) do show unmistakable correlation in respect of long-period variations of the two, for example, seasonal variation and eleven-year solar cycle variation[4,5,6].

For the case of short-period nightly variations, however, one would not expect too close a correlation between the two. This is because the nightly variation of f_F^2 may not correspond to the variation of the total electron content of the region, on which latter, obviously, the intensity of night-sky emission depends. Thus the total number of electrons in a column of unit cross-section may remain constant or even decrease, but f_F^2 may show an increase due to contraction of the layer as a whole by cooling. Again, the decrease in f_F^2 due to recombination proceeds much faster than the decrease in the total electron content due to the same cause.

There are, however, 'disturbed' nights on which f_F, as also the intensity of the night sky, vary abnormally. On such nights the variation of f_F^2 follows the variation of the electron content of the region as a whole and, as such, one may expect a positive correlation between the two. This is precisely what has been found, and furnishes evidence in support of the theory. Taking advantage of the black-out condition in the city, Mr. S. N. Ghosh (Adair Dutt Research Scholar) has, for some time past, been keeping in my laboratory records of night-sky intensity variation on dark clear nights on which f_F records were also being kept. It was found that on undisturbed nights on which the night-sky intensity shows a typical variation, f_F^2 also does the same, the two variations not necessarily following each other. On disturbed nights, however, on which f_F^2 exhibits abnormal variation, the night-sky intensity also varies abnormally, following the same trend. The accompanying figure depicts two such variation curves. It will be seen that they run approximately parallel to each other.



The night-sky intensity was measured photographically without any filter in the region 6° above the pole star. The photographic records were measured by a Moll microphotometer.

S. K. MITRA.

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Calcutta. March 29.

[1] Mitra, S. K., *Science and Culture* (Calcutta), 9, 46 (1943). See also Ghosh, S. N., *Proc. Nat. Inst. Sci. Ind.*, 9, 301 (1943).
[2] Lozier, W. W., *Phys. Rev.*, 46, 268 (1934).
[3] Vier, D. T., and Mayer, F. E., *J. Chem. Phys.*, 12, 28 (1944).
[4] Rayleigh and Jones, H. S., *Proc. Roy. Soc.*, A, 151, 22 (1935).
[5] Martyn, D. F., and Pulley, O. O., *Proc. Roy. Soc.*, A, 154, 455 (1936).
[6] Smith, N., Gilliland, T. R., and Kirby, S. S., *J. Nat. Bur. Stand.*, 21, 835 (1938).

X-Ray Topographs

WHERE a sizable crystal is to be used for investigations of structure-sensitive properties, for example, X-ray intensity measurements, photo-electric effect, etc., it is advisable to test its homogeneity. This may be simply done in the following way.

The crystal is irradiated by a wide beam of appropriately filtered X-rays, diverging from a pinhole placed close to the anticathode. A small piece of flat photographic film is mounted in a holder on the axis about which the crystal oscillates. The film is arranged to be parallel to the face of the crystal which it is required to examine. The crystal is then placed in the position for a Bragg reflexion to occur for this face, and the crystal and film are then oscillated through an angle sufficient for every part of the crystal to reflect. We have found Kodak Process film very satisfactory for this purpose and better than Crystallex, because, though its sensitivity is less, it is much finer grained.

With this arrangement an almost undistorted topograph of the surface of the crystal may be obtained with copper radiation. This is because the characteristic radiation is reflected at a constant angle from all parts of the surface and the image is built up, piece by piece, as the crystal rotates in the diverging beam.

We have investigated a number of diamonds by this method. The topograph of a face sawn through one peculiar interpenetrating twin of diamond is shown in the accompanying photograph, and it is seen that the reflecting power for X-rays varies greatly over the surface. This diamond showed no visible irregularities.

Associated with the stronger reflexions there is frequently found a streak extending sometimes on both sides of the central position. This is due to the 'angular spread' of the polycrystalline material at the reflecting spot. This method is therefore a convenient one for studying variations of texture of the material, which include relatively large-scale imperfections corresponding to a visible angular spread and small-scale imperfections corresponding to variations in intensity of reflexion at the correct setting of the crystal.

Another diamond which was investigated in this way was sent to us for examination because of its anomalous behaviour in an abrasion test. The stone had been sawn in half, approximately parallel to the cube axis. One half had ground away at the normal rate, the other had proved extraordinarily resistant. Topographs of the ground surfaces were strikingly different, the part which had behaved normally showing a uniform reflecting power, but the part which had behaved abnormally showing obvious irregularities.

Topographs of these two pieces taken on the sawn faces were also interesting, showing quite clearly the existence of a skin. That the outside of a diamond frequently grinds at a different rate from the interior is alleged by most diamond cutters; but the evidence for it that is offered is generally subjective and not easily checked.

While we would not wish to maintain on the basis of this scanty evidence that resistance to abrasion is necessarily correlated with the perfection of the crystal structure, we suggest there is a *prima facie* case for investigation on these lines.

The topographs taken by G. N. Ramachandran[1] are in a sense complementary to those described here. He uses a Laue method and, by making use of hard radiation, examines the whole bulk of the stone, whereas we examine the superficial layers only.

We wish to thank Mr. Paul Grodzinski, of the Research Department of the Diamond Trading Co., for providing the stones and abrasion data, and for permission to publish these results.

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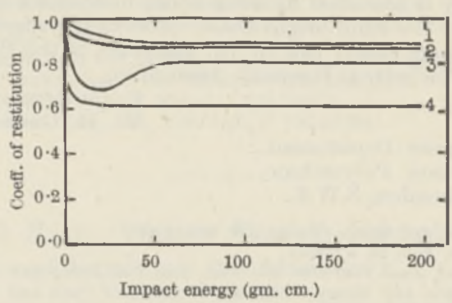
[1] Ramachandran, G. N., *Proc. Ind. Acad. Sci.*, 19, A, 280 (1944).

Coefficient of Restitution of Coals

In a previous note[1] it was mentioned that mechanical properties are involved in the Stopes' classification of the petrological constituents of coals[2], and they are of interest in any general study of the physical properties of coals. Much of the previous work on this subject has been undertaken from the point of view of mechanical failures in mines, or breakage in handling. Stress-strain relationships for coals have been obtained[3] by compression methods using large-scale engineering test machines, and while our experiments were in progress Bangham and Maggs[4] reported measurements of the elastic moduli of coals in expansion on adsorption of vapours and in mechanical compression on a small scale.

Where the interest lies in the physical structure of coal, it is difficult to get a uniform specimen sufficiently large for direct measurement of the elastic moduli by a simple method. Although the coefficient of restitution is a composite constant, more difficult to treat theoretically, its measurement is simple even with small specimens, and the results are likely to reveal any essential differences in the elastic properties of a series of specimens. The height of rebound of small steel spheres dropped vertically on to a polished plane surface of the specimen was measured for a number of coals of varying rank. The mass of the spheres varied from 0·1 gm. to 12 gm. and the height of fall from 5 cm. to 15 cm. As a check on the technique, blocks of several metals including copper and mild steel were substituted for the coal specimen. It was found that the coefficient of restitution varied with the impact energy of the sphere, but that for any given value of this energy the results were independent of the size of the sphere.

A selection from the results is given in the accompanying graph. Curve 1 is for an anthracite from South Wales, curve 2 for durain from a Warwickshire hard coal, curve 3 for vitrain (with some clarain bands) from a Warwickshire bright coal, and curve 4 for copper.



It was found that for all specimens examined, both coals and metals, at very low impact energies the coefficient of restitution tended towards unity with decreasing impact energy. The curves for all specimens of anthracite and durain examined and for metals were similar. With increasing impact energy, the coefficient of restitution drops from the initial high value and rapidly reaches a constant value. The specimens of the lower-rank bright coals, however, all exhibited a minimum in the coefficient of restitution at fairly low impact energies, the coefficient increasing to a constant value at higher energies. This minimum is clearly shown in the graph for Warwickshire bright coal (curve 3). At the higher impact energies the constant values of the coefficient of restitution for the coals examined varied from 0·75 to 0·90, values considerably higher than those got for metals such as copper (0·62) and mild steel (0·73).

The coals which exhibited a well-defined minimum in the 'restitution-impact energy' curves were all bright coals which are in general much more brittle and friable than durains and anthracites, and in which occur visible cracks and well-defined cleavage planes. The depth of the minimum and the value of the impact energy at which it occurred varied from coal to coal. The minimum could indicate that at each impact an absorption of energy occurs in addition to the elastic strain energy absorbed. The additional amount of energy absorbed would initially increase from zero at zero impact energy, but rapidly reach some constant value independent of the impact energy of the sphere.

While the mechanism of this additional absorption of energy remains obscure, the effect has been suspected by previous workers. Holland[3] observed that coals subjected to high compression stresses exhibited hysteresis and permanent set, and only 85 per cent of the energy was released on removing the stress, 15 per cent strain energy being absorbed as permanent strain or appearing as heat. He suggested that the violence of rupture observed indicated that a large portion of this energy was released on failure of the specimen. In their mathematical treatment of coal breakage, Bennett, Brown and Crone[5] formulated the hypothesis that, under stresses producing breakage, coals behave as brittle materials with a random distribution of inner planes of weakness. On fracture the energy is absorbed in forming new surfaces of the fragmented product, and in the creation of fresh inner weaknesses. As Heywood[6] pointed out, this hypothesis neglects any elastic strain energy which may be absorbed, that is, assumes perfect elasticity. The experiments described above show that, with impacts too small to produce fracture, elastic deformations occur which absorb energy (since the coefficient of restitution is less than 1) and, in addition, energy is absorbed by some other mechanism in the case of low-rank bright coals. Most of the specimens used were kindly lent by Dr. Bangham of the British Coal Utilisation Research Association.

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[1] Cannon and George, *Nature*, **150**, 690 (1942).
[2] Stopes, *Fuel*, **14**, 4 (1935).
[3] Holland, *Amer. Inst. Min. Met. Eng.*, Tech. Pub. 1406 (1942) 19 refs.
[4] Bangham and Maggs, "Ultrafine Structure of Coals and Cokes" (B.C.U.R.A., 1944).
[5] Bennett, Brown and Crone, *J. Inst. Fuel*, **10**, 22 (1936); **14**, 111 (1941).
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Explanation of the Broadness and other Characteristics of Association Bands

THE broadness of the OH, NH or similar bands of pure liquids is well known, and there have been many postulates regarding its origin[1,2,3]. We wish to show here that it is not necessary to assume any involved postulates regarding it, as it can be explained merely from the modern ideas of the mechanism of the formation of the hydrogen bond.

Pauling has shown that a covalent link has a partially ionic character. In the case of OH, for example, H is sometimes an atom enjoying a shared pair of electrons and sometimes a mere proton, the pair of electrons being attracted towards O by its electronegativity. The two states alternate with what is called a resonance frequency. During the time H is a proton, it can approach another negative atom, say, O, for intense attractive interaction. Thus the H atom in a hydrogen bond moves between two points, say A and B, A being the position nearest its parent O, and where it rests ordinarily in the absence of a hydrogen bond:

O ——— A ——— B .... O.
H

Now, corresponding to each point of occupation by H on AB, there will be an OH band, with its own frequencies, and as the force constant will go on decreasing on proceeding from A to B, the breadth of the band is inherent in the formation of a hydrogen bond. Some other pertinent facts associated with hydrogen bonds are also explainable on the above mechanism.

(1) The breadth of the OH band will be greater the stronger the hydrogen bond. As AB increases with the strength of the hydrogen bond, the breadth increases. Thus carboxylic acids possessing the strongest hydrogen bonds have the widest character of the association bands.

(2) As the concentration of molecules containing OH increases in an inert liquid, the association band will develop as a whole, that is, the character of the band remains independent of the concentration and only the intensity increases. As the association band due to hydrogen bonds arises in a complete form from each pair of molecules involved in a single hydrogen bond, the fact noted above follows.

(3) Since A is the limit of travel of the H proton (this being its rest position in the absence of hydrogen-bond formation), the high frequency limit of the association band will end sharply at the high-frequency limit of the normal unassociated OH band.

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Lahore.
March 1.

[1] Bauer and Magat, *J. Phys. et le Radium*, **9**, 319 (1938).
[2] Badger and Bauer, *J. Chem. Phys.*, **5**, 839 (1937).
[3] Sutherland, *Trans. Farad. Soc.*, **36**, 889 (1940).

Hæmolytic Disease of the New-born caused by the Antibody *St*

RECENTLY hæmolytic disease of the new-born was described[1] where the $Rh+$ mother had in her serum an antibody since designated St[2] or γ[3]. From the observations of Race, Taylor and their collaborators[4,5,6] the reactions of the known allelomorphs of the Rh gene with St serum may be summarized thus:

	Rh_2	Rh_0	Rh''	rh	Rh_1	Rh'	Rh_z
St serum	+	+	+	+	−	−	−

An eighth allelomorph, Rh_y, which is St^-, is postulated by R. A. Fisher[3,6].

The genotypes found in the *St* family were: mother, Rh_1Rh_1; first and third children, Rh_1rh; father, Rh_1rh. The first child was unaffected. The second child died from hæmolytic disease; its genotype is not known, but is presumed to have been Rh_1rh. The third child recovered from hæmolytic disease after transfusion with St^- blood. Since this family was first described an unaffected fourth child, genotype Rh_1Rh_1, has been born; no augmentation of the mother's antibody occurred with this pregnancy.

We have now observed a second family with hæmolytic disease of the new-born caused by the *St* antibody. The known genotypes are: mother, Rh_1Rh_1; affected child (the second pregnancy), Rh_1rh; father, Rh_2rh (Rh_2Rh_2 and Rh_2rh are not distinguishable with the sera available to us, but the father is evidently heterozygous). The first child died in circumstances suggesting hæmolytic disease. The second child, mentioned above, died from hæmolytic disease, and a third pregnancy has recently terminated in abortion at the fourth month.

The mother's serum was examined after her second pregnancy and an antibody was found which agglutinated all of 35 Rh^- group O bloods tested. Identical results were observed using the original *St* serum and the new serum on a panel of 41 group O bloods (35 +, 6 −). The probability of observing this result by chance is less than 1 in 4 million (6 ! × 35 !/41 !)[7], and it was evident that identical antibodies were present in the two sera. The new serum also gave the 'dosage effect' observed with the original *St* serum[4]; that is, the titre was considerably higher for erythrocytes containing two St^+ antigens than for those containing one such antigen. It is supposed that in both cases the St^- mother was immunized by fœtal *rh*; the birth of a normal fourth child (Rh_1Rh_1) in the first family is consistent with this hypothesis.

There is evidence[8,9] that about 90 per cent of mothers bearing children affected by hæmolytic disease are Rh^-, and that the disease results from iso-immunization of the Rh^- mother by an Rh^+ fœtus (*Rh* iso-immunization). The disease is much more likely to appear when the father is homozygous, and every pregnancy (all Rh^+) can provide an antigenic stimulus; in these circumstances the prognosis for future pregnancies in an affected family is entirely unfavourable[10,11].

It is of interest to estimate the frequency of matings and pregnancies in which *St* iso-immunization might occur. If only the common genes Rh_1, Rh_2 and *rh* are considered, the mother, who must be St^-, can only be Rh_1Rh_1. Theoretically, fœtal Rh_2 may cause *St* iso-immunization, and although this does not seem to have been observed it may have occurred with the first and third pregnancies in our second family. From analogy with *Rh* iso-immunization it would seem that when hæmolytic disease occurs from *St* iso-immunization and the father is *rh rh*, the prognosis for future pregnancies is entirely unfavourable (all children Rh_1rh); and if fœtal Rh_2 may cause *St* iso-immunization the outlook is similarly unfavourable with Rh_2Rh_2 and Rh_2rh fathers. Using the frequencies suggested by Taylor and Race[12] for the common genotypes (*rh rh*, 13; Rh_1Rh_1, 19; Rh_1rh, 33; Rh_1Rh_2, 13; Rh_2rh, 12; Rh_2Rh_2, 2 per cent) we obtain approximate estimates of matings and pregnancies in which *St* iso-immunization might occur: (1) Including Rh_2 as an immunizing antigen (*a*) St^- women and St^+ men, 13·9 per cent of all matings; (*b*) St^+ pregnancies with St^- mothers, 9·5 per cent of all pregnancies. (2) If fœtal Rh_2 is excluded the corresponding figures are (*a*) 11 per cent; (*b*) 6·7 per cent. Applying the same genotype frequencies to ordinary *Rh* iso-immunization of *rh rh* mothers, we get: (*a*) Rh^- women with Rh^+ men, 10·3 per cent of all matings; (*b*) Rh^+ pregnancies with Rh^- mothers, 7·3 per cent of all pregnancies. From these data it might be expected that *Rh* and *St* iso-immunization would occur with about equal frequency, but since some 90 per cent of mothers bearing children with hæmolytic disease are Rh^-, it is clear either that *St* iso-immunization occurs much less frequently or that its effects are usually unrecognized.

The relative infrequency of recognized *St* iso-immunization requires explanation, and it may be supposed either that the St^+ antigens are usually weak, or that there is a selective placental impermeability to them. In support of the first hypothesis is the fact that although the occurrence of transfusion reactions from *Rh* immunization is well established, no similar reactions from *St* immunization appear to have been recognized.

In addition to the two examples observed by us, we are aware of a few other cases of hæmolytic disease in which *St* antibody has been found, and it seems not unlikely that *St* iso-immunization was responsible for the disease in the three families mentioned by Race, Taylor *et al.*[10] with Rh^+ mothers and Rh^- husbands.

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The Race – Wiener Test in Hæmolytic Disease of the New-born

Race[1] and Wiener[2] described in 1944 independently a peculiar phenomenon concerning the *Rh* agglutination. When Rh^+ red blood corpuscles were incubated with some sera which did not agglutinate them, a further incubation with potent anti-*Rh* sera failed to produce an agglutination of these cells. Race called the antibody present in such sera the 'coating' or 'incomplete' antibody; Wiener designated the test as a 'blocking' test and called it the "counterpart of the inhibition test for haptens and group-specific substances". Wiener as well as Race and Taylor[3] stressed the fact that by means of this test iso-immunization can be detected in Rh^- women when ordinary agglutination tests fail to give such evidence.

No investigations on sera of babies with hæmolytic disease of the new-born have been yet reported. Anti-*Rh* agglutinins are only exceptionally met with in sera of babies with hæmolytic disease of the new-born. Boorman, Dodd and Mollison[4] observed once their presence in twins, and I reported[5] one weakly positive test in a case of icterus gravis neonatorum. Since then, I have seen one definite reaction in the cord serum of a hydrops fœtalis and four weakly positive agglutination tests in icterus gravis neonatorum. Since the publications of Race and Wiener their test has been applied to sera of fifteen babies with hæmolytic disease of the new-born, to nine sera of Rh^- negative mothers of such babies which gave negative or doubtful reactions in routine anti-*Rh* tests, and to four sera of Rh^- women with a history of miscarriages but no clinical or serological evidence of iso-immunization. Among the fifteen sera of babies there were seven positive Race-Wiener tests, six negative and two doubtful. All nine sera of mothers of babies with hæmolytic disease of the new-born gave positive results. In the last group there were three negative and one positive result.

Not all Rh^+ red blood cells are suitable for this test. According to Race[1], sera giving a positive blocking test have an incomplete Δ agglutinin acting on the partial agglutinogen which has been designated by Fisher as *D*. Red blood cells of the phenotypes Rh_1, Rh_2, Rh_0 and Rh_z, which together form the majority of Rh^+ cells, possess the *D*-agglutinogen and can therefore be coated by the incomplete antibody. Fisher's theory appears at the present moment to be the most satisfactory explanation of the intricate *Rh* agglutination phenomena.

I think it premature, however, to be dogmatic about a definite conception of the antigenic structure of the *Rh* factor. We have to realize that Landsteiner's[6] investigations on conjugated antigens have shown that to a mosaic of serological reactions there need not always correspond a co-ordinate mosaic of chemical structures in the antigen. Whatever be the explanation of the hapten properties in the eight known *Rh* allelomorphs, the fact remains that some Rh^+ cells fail to be coated in the Race-Wiener test, and that the inhibition may be complete in some specimens and only partial in others. For this reason I always use for the test ten different samples of Rh^+ red blood corpuscles in two parallel series, one treated with the patient's serum, the other with the serum of an Rh^+ individual. Into each of ten small test tubes (45 mm. length, 7 mm. bore, round bottom) 0·04 c.c. of the patient's serum is delivered from a marked Pasteur pipette. In a second series of tubes equal amounts of the control serum are placed. 0·04 c.c. of 2 per cent suspensions of ten different Rh^+ red blood cells are then run into each tube of the test and control series. Both are incubated for one hour. After this time 0·04 c.c. of a suitable dilution of a potent anti-*Rh* serum is added to each tube, the tubes thoroughly shaken and reincubated for another hour. The test is positive when the majority of samples in the test series show definitely weaker reactions than those in the control series or no agglutination at all. The highest dilution of the standard anti-*Rh* serum which still produced coarse agglutinates in a suspension of standard Rh^+ cells was considered as suitable for this test.

From the foregoing discussion, it is evident that the Race–Wiener test enables us to diagnose in an appreciable number of cases iso-immunization from the babies' sera, to ascertain iso-immunization when the mother's serum does not agglutinate Rh^+ cells and to decide occasionally in cases of Rh^- women with a history of miscarriages whether iso-immunization has taken place.

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Kojic Acid and the Antibiotic Action of Species of *Aspergillus*

IT was shown recently[1] that under specified cultural conditions the whole of the antibacterial activity of metabolism solutions from *Aspergillus effusus* Tiraboschi can be attributed to kojic acid. It was suggested that this common mould metabolic product might similarly account for the inhibitory properties of other fungi.

Some time ago, in a preliminary account of the production of antibiotics by selected species of *Aspergillus*[2], we described the formation by *A. parasiticus* of a material resembling penicillin. In investigating the effect of varying cultural conditions on antibiotic production by this and other species, kojic acid was often observed to be present in the metabolism solutions, but there was ample evidence of the formation of other antibiotics in addition. The observations described below, which were repeatedly confirmed, are recorded with special reference to *A. parasiticus* because of the marked tendency of this mould to produce kojic acid[3].

When *A. parasiticus* was grown on a Czapek-Dox synthetic medium with the addition of 0·1 per cent 'Difco' yeast extract, it ceased to give the penicillin-like antibiotic reported earlier; the solutions developed antibacterial activity against *Staphylococcus aureus*, which was not lost on standing the solutions at pH = 1·8 or 11 for 90 min. and was only partly lost after heating to 90° for 30 min. Further tests showed that the antibacterial activity of the culture fluids varied with the amount of sugar present in the medium. In solutions containing 0·5 or 1 per cent glucose, activity against *Staphylococcus aureus* appeared about the twelfth day and the solutions remained active for three to four weeks; colour tests for kojic acid were negative throughout this period and the solutions were entirely inactive against the Gram-negative organisms *E. coli* and *Ps. pyocyaneus*. In 2 per cent glucose solutions kojic acid was present, and slight activity against *E. coli* and *Ps. pyocyaneus* developed from the fifth to the seventh day, after which all activity disappeared until about the thirteenth day, when antibiosis was again produced but against *S. aureus* only; tests for kojic acid were then negative. In 4 per cent glucose solutions the dual phase of activity became still more marked. Activity against *S. aureus* appeared about the fifth day, reached a maximum on the eleventh day and then fell sharply to zero. Tests at 18–22 days were completely negative, but the culture fluids were again active about the twenty-fourth day and were still active after fifty days. During the first phase kojic acid was present in the solutions, which were active not only against the Gram-positive organisms *Staphylococcus aureus*, *B. megatherium* and *Bact. fascians*, but also against a range of Gram-negative bacteria, namely, *E. coli*, *Ps. pyocyaneus*, *Chr. prodigeosus*, *Ps. fluorescens liquefaciens*, *Bact. aerogenes* and *B. carotovorus*. During the second phase the solutions inhibited the growth of Gram-positive organisms only.

When 1, 2 or 4 per cent lactose was used in place of glucose, all the lactose cultures and those containing 1 and 2 per cent of maltose were similar in antibiotic production to those containing 1 per cent of glucose; in 4 per cent maltose antibacterial activity exactly paralleled that produced in 4 per cent glucose solutions, with a transient formation of kojic acid during the first phase of activity.

Attempts were made to find convenient substitutes for yeast extract, without which antibiosis was considerably delayed and was less pronounced. Freshly prepared extract of bakers' yeast and an extract of lettuce seedlings were effective supplements, but individual compounds such as aneurin, lactoflavin, pantothenic acid, pyridoxine, *p*-aminobenzoic acid, or heteroauxin, were almost valueless. The dual phase of activity when 4 per cent glucose was used in these media was apparent in the culture fluids of all these solutions, though it was not always so clearly marked as in the experiments described above.

Clearly at least two antibiotics were produced in these experiments, the speed of their production apparently depending on the availability of the carbohydrate nutrient; but it is possible for the following reasons that more than two antibiotics were being formed. (*a*) The activities against the range of organisms examined did not run parallel during the first phase. For example, in 4 per cent of glucose after eight days, the solutions inhibited *Staph. aureus* at a dilution of 1 : 100, with only a trace of activity against *E. coli*; after ten days the solution was about equally effective (limiting dilution 1 : 100) against these two organisms, whereas after sixteen days it was less active against *Staph. aureus* than against *E. coli*. (*b*) During the early part of the first phase of activity, kojic acid was detectable in solution and was readily isolated; its activity proved to be small, as it inhibited *Staph. aureus*, *E. coli* and *Ps. pyocyaneus* at a limiting dilution of 1 : 2,000–3,000, and there was a very considerable discrepancy between the amounts of kojic acid isolated and the amounts which would have been anticipated if it had been responsible for all the antibacterial activity. Moreover, kojic acid disappeared from the solutions before the latter part of the first phase was reached and did not reappear during the more restricted second phase.

Several products from kojic acid (for example, mono- and di-acetyl, monobenzyl, monomethyl ether derivatives) were examined, but their effectiveness against *Staph. aureus* was negligible. The antibiotic produced during the second phase was easily extracted from acid solution by ethyl acetate and the activity could be recovered in neutral solution. The chemical nature of these products is being examined. It is evident in these experiments that even though kojic acid is produced, only a part of the antibacterial activity can be ascribed to this compound.

We thank Prof. I. M. Heilbron for his encouragement and the Rockefeller Foundation for financial assistance.

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Root-formation on Cuttings of Plants which Normally do not Root

The process of rooting of cuttings has proved to be a very complex problem. A good deal of work has shown that root-formation on stem and leaf cuttings depends on many factors, of which auxin and carbohydrate are the most important[1,2,3]. This work has enabled many investigators not only to produce, more quickly, more numerous roots on cuttings which normally root easily, but also to induce root-formation on cuttings which normally do not root. Thus Cooper[4,5], Hitchcock and Zimmerman[6], and many others have obtained excellent root-formation on cuttings of many economically important plants by application of auxin alone or with sugar solution.

In the present investigation, we are trying to induce rooting of cuttings from *Bougainvillœa spectabilis* var. *Lateritia*, and *Mangifera indica*. Cuttings of *B. spectabilis* usually root successfully (success is normally 50–60 per cent); but cuttings from the variety *Lateritia* do not root normally. We have, however, succeeded in inducing root-formation on 50 per cent of woody cuttings from the latter variety by basal application of β-indole acetic acid solution. Different concentrations of the latter have been used for different periods of time, the optimum concentration being 0·015 per cent for a period of twelve hours. Feeding with sugar solution after the application of hetero-auxin did not increase the number of rooted cuttings, thus suggesting that the cause of failure of these cuttings to root under normal conditions is the shortage in the auxin and not the food factor.

Cuttings of *Mangifera indica* have been more difficult to root; but the experiments, which are now in progress, seem to indicate that these cuttings do respond to auxin application. Basal application of β-indole acetic acid solutions induced formation of root initials on these cuttings (collected last autumn), but the cuttings shrivelled and died later in the winter. Cuttings will be collected and treated in different seasons, and the results will be communicated later.

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Two Colour-Types in *Solitaria*-Phase Adults and Hoppers of the Desert Locust

COLOUR differences between the *gregaria* and *solitaria* phases in the desert locust, *Schistocerca gregaria* (Forskål), are well known. In the *gregaria* phase the adults are pink when immature and yellowish when mature (Künckel d'Herculais[1]); *solitaria* adults are greenish when very young and greyish afterwards (Johnston[2]). *Gregaria*-phase hoppers have a black pattern; *solitaria* hoppers lack this pattern and are green (Johnston[2], and others). (*Vide* also Kennedy's[3] recent account of coloration in *solitaria*.)

I have however observed, both in Nature in Baluchistan as well as in the laboratory, that two distinct colour-types occur in the *solitaria* phase among adults and hoppers. (i) *Adults*. Among 367 adults examined, the majority (about 91 per cent) were suffused with a blue-grey tinge, resembling the *solitaria* individuals mentioned by Johnston; others (about 9 per cent) had no blue-grey but were fawn all over. The occurrence of the two types has no relation to age or season. (ii) *Hoppers*. The majority of *solitaria* hoppers are green. Occasionally, however, both in Nature and in the laboratory, fawn-coloured hoppers, with no trace of green, turn up, as briefly reported earlier in an account of my painted-box experiments (Roonwal[4]). Though exact figures are not available, my distinct impression is that the frequency of occurrence of the fawn hoppers did not exceed about 10 per cent. The colour difference was especially noticeable from the third stage onward, and was not correlated with the environment, as shown by rearing experiments as well as field observations.

It is probable that (*a*) the fawn hoppers give rise to fawn adults, and green hoppers to the blue-grey adults; and (*b*) the two colour-types have a genetical significance, since they are not related to phase or environment.

A detailed account will be published elsewhere.

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Chemical Constitution of the Nucleolar Inclusions in Growing Oocyte Cells

IN many animals during the second period of growth of the oocyte there is a production of nucleolar substance by means of a multiplication of numerous little nucleoli, or the budding of small nucleoli from a principal nucleolus[1]. When a principal nucleolus exists, in general concomitantly with the production of the buds, some inclusions with a more or less vacuolar appearance are formed in its interior[1]. In a study of the nucleolar physiology in two species of Helicidæ—*Helix aspersa* Müll. and *Tachea nemoralis* L.—we have examined the constitution of these inclusions. They are not aqueous vacuoles; though they can be, and probably in general are, less dense than the body of the nucleolus; when centrifuged they are not markedly dislocated and in concentrated salt solutions the volume of the inclusions does not diminish more than the rest of the nucleolus.

By means of the histochemical arginine reaction[2] we have seen that these inclusions are less rich in arginine than the body of the nucleolus. Millon's reaction for tyrosine and the test for protein SH groups[3] are also less strong in the inclusions. On the other hand, Voisenet's reaction for tryptophan[4] gives a violet coloration more intense in these inclusions.

The Feulgen reaction is completely negative for the nucleolus and the inclusions, while a histochemical test for organically bound phosphorus is positive for the nucleolus body and is more intense in the inclusions. This phosphorus test consists essentially in a slow hydrolysation of the tissues by a molybdate-hydrochloric acid reagent followed by treatment with an acetic solution of benzidine and saturated aqueous sodium acetate[5]. This test demonstrates the presence of phosphorus in thymo- and ribo-nucleic acids, and the reaction is very intense, for example, in the spermatozoa heads and the chromosomes of dividing cells. The test reveals the presence of phosphorus in conjugated phospho-proteins and specially in nucleoproteins.

The coloration of the oocytes with basic (toluidine blue) and acidic (Ponceau *PR*) stains, minimizing at the same time the adsorption[6] by addition of 1 per cent saponine, gives results which agree with the histochemical tests. Toluidine blue gives a coloration more intense in the inclusions than in the rest of the nucleolus, while the contrary happens with Ponceau. By means of nucleases extracted from rice bran[7] we have digested the nucleic acids. After this digestion, the inclusions do not show any differential response to staining and the phosphorus test is negative.

It is known that the nucleolus is formed of, at least, basic proteins and also some non-basic proteins[7,8], and nucleotides of the ribose type[8]. It seems that we can safely conclude that the phosphorus reaction, the coloration with basic and acidic stains and the nuclease action, show the existence of nucleotides of the ribose type in the nucleolus, and the nucleolar inclusions must have a greater concentration of these nucleotides than the remaining part of the nucleolus. It would be interesting to test the same material by means of the ultra-violet microscope.

This accumulation of nucleotides in the inclusions is probably related to the production of nucleoproteins rich in basic proteins, by the nucleolus during the elaboration of the cytoplasm and the yolk of the growing oocyte. The nucleoli are more rich in nucleotides (phosphorus test) when young. It is possible that the synthetization of nucleotides is a function of the nucleolar inclusions, while the basic proteins are particularly formed in the nucleolus body.

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A Simple Method for the Establishment of Geometrical Progressions by Diluting with the Pipette

IN serology and biochemistry it is a daily task to ascertain by so-called serial tests the effective dose of any substance; for example, to establish the titre of the agglutinating power of a serum, to find the strength of a hæmolytic amboceptor, or the smallest concentration of salt that just precipitates a colloidal solution, etc.

We can carry out the serial tests by preparing solutions of the substance in question in the form of an arithmetical or geometrical progression. Michaelis and Rona[1], and many others, have shown, however, that this procedure as it is often carried out is the source of various errors, when the series are laid out in the form of arithmetical progressions.

Let us, for example, examine the sodium chloride series which was prescribed by Kafka for the establishment of the smallest gold-sol precipitating salt concentration (or mastic-sol ones).

Salt conc. (%)	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9	1·0	1·1	1·2
Difference (%) between various tubes	100	50	33	25	20	16	14	12·5	11	10	9	

The variation in percentage differences between consecutive concentrations in the above series is clearly undesirable for quantitative estimations. In the great majority of cases it is necessary to estimate, with approximately the same percentage error, at whichever part of the series of dilutions the indicating tubes occur. This is ensured by the use of serial dilutions, in which the ratio of concentrations of the reagent in any two adjacent tubes is the same throughout the series. The preparation of such a geometrical series with any required ratio of concentrations between the contents of adjacent tubes is much facilitated by the use of a simple algebraic formula.

A series of tubes is placed in a row. Into the first tube a convenient amount (V) of the reagent is accurately measured. Into each of the remainder of the tubes the same volume of the diluent is measured. Into the second tube is measured also a volume (K) of the reagent, where

$$K = \frac{V}{Q-1},$$

Q being the ratio of concentration between the contents of adjacent tubes, which is appropriate for the experiment. The contents of tube 2 are then thoroughly mixed and a volume K of the mixture transferred from tube 2 to tube 3. After mixing, a volume K is transferred from tube 3 to tube 4, and so on through the series.

As an example, we may revise the Kafka salt concentration series cited above. If we arrange the twelve dilutions in a geometrical series, the value of Q to cover the range of dilutions from 0·1 to 1·2 per cent is 1·2535. This is arrived at by dividing the difference of the logarithms of 1·2 and 0·1 by 11 (the number of intervals between tubes) and taking the antilogarithms. If we use $Q = 1{\cdot}25$, the highest concentration should be 1·16 per cent instead of 1·2 per cent. Then with $V = 0{\cdot}5$, $Q = 1{\cdot}25$, $K = \frac{0{\cdot}5}{0{\cdot}25} =$ 2 c.c.; 0·5 c.c. of the 1·16 per cent solution is put into tube 1 and 0·5 c.c. of the diluent into each of the other tubes. The 2 c.c. of 1·16 per cent is added to tube 2, mixed, and 1 c.c. of the mixture transferred to tube 3; 2 c.c. is then transferred from tube 3 to tube 4, and so on.

If the same pipette is used for each of the successive dilutions, it is important that it should be a very accurate one, as any errors in its calibration cumulate rapidly. If, for example, a 5 per cent deficiency occurs at every stage of successive dilution, the last tube of a series of twelve will have little more than half its true concentration.

In conclusion, I should like to express my sincerest thanks to Dr. J. W. Trevan, director of the Wellcome Physiological Research Laboratories, for criticisms and advice.

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Potato Dry Rot and Gangrene as Soil-borne Diseases

DRY rot was described as a storage disease of the potato nearly forty years ago[1,2], and has since become of increasing economic importance; yet only recently has attention been paid to the soil as a source of infection. The control of the disease obtained by the use of organo-mercury dips at lifting time[3] and the marked variation in its severity in stocks of the same variety from different farms lent support to the assumption that the causal fungus (*Fusarium caeruleum*) was soil-borne. No attempt had, however, been made to provide direct experimental evidence of this until last year, when Small[4,5] showed that *F. caeruleum* was often present in the soil adhering to healthy tubers both at lifting time and during storage.

We have carried out experiments to determine the presence of the fungus in soils from selected fields in Scotland and to discover whether any variations could be detected in the degree of infestation. In the autumn of 1943, bulked random samples of soil were taken, with aseptic precautions, from twenty fields. Potatoes of the susceptible variety Doon Star were inoculated with small quantities of the soils, twenty-five tubers, each inoculated in two places, being used for each sample. A fresh sterilized inoculator was used for each tuber.

RESULTS OF INOCULATING POTATO TUBERS WITH SOIL TAKEN FROM TWENTY SCOTTISH FIELDS IN OCTOBER 1943.

Date of last potato crop	Number of fields	Percentage of inoculations causing dry rot
1941	1	32
1942	11	52, 22, 16, 10, 6, 6, 4, 2, 2, 0, 0
1943	8	88, 24, 20, 4, 4, 4, 2, 0
Control: sterilized soil		2
Control: spore suspension of *F. caeruleum*		100

The infection of one wound in the first control series was presumably due either to imperfect sterilization or to chance air-borne contamination.

Isolations from random samples of infected tubers showed that the causal organism in almost every case tested was *F. caeruleum*.

The results summarized in the table show that *F. caeruleum* may be present in the soil at least two years after the last potato crop, and that marked variations in the degree of infestation of the soil samples were detected by the method used. Experiments on a larger scale are now in progress to ascertain whether such variations can be correlated with the amount of dry rot developing naturally in tubers of susceptible varieties taken from the same fields as the soil samples. Further investigation is necessary to determine whether the fungus is a normal inhabitant of certain soils or a soil invader[6].

Gangrene caused by *Phoma foveata*[7] has also been assumed to be a soil-borne disease, although, so far, there has been no experimental evidence of this. During a previous experiment, we isolated *P. foveata* from typical gangrene lesions developing on some tubers inoculated with soil from two fields in Scotland, both of which had last been cropped with potatoes in 1942, that is, one year before the soil samples were taken. This disease, therefore, may also be regarded as soil-borne.

Details of the above experiments and other work on the epidemiology and control of dry rot are in the course of preparation for publication.

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Mass Production of Virus-free Potatoes

Under the powers given by the Agricultural Pests Act, 1911, a reserve comprising the Riet River Settlement and all land within ten miles of it[1] has been set aside for growing virus-free potatoes. The Settlement is one of the newer irrigation projects in the Union. It is now being farmed by the State in preparation for the return of men from the armed forces who will occupy it after the War; and it was partly to provide them with a new and profitable industry that the reserve was created.

But primarily the object of the reserve is to break away from the ordinary system of seed production, in which the aphid-transmitted viruses are permitted in small amounts and at least those strains of virus *X* allowed which cause no visible mottling of the leaves. Circumstances have brought this system about, but although it has been almost universally accepted we should not delude ourselves that it is anything but the makeshift that it is. The plants with aphid-transmitted virus diseases are always a danger, even if they are only few, and except in the very best areas the grower is committed to an endless battle against infection spreading from them. The worst strains of virus *X* can be kept in check by destroying mottled plants, but under the present system milder strains spread unhindered. A few years ago this might not have seemed a serious objection, but we now know that even the weakest strains which cause no visible symptoms on potatoes substantially reduce the yield[2,3].

The only way to deal with virus *X* in susceptible varieties and the best way with other viruses is to get rid of them altogether. Bald[4] tells how stocks free from virus *X* are being grown in Australia. In Britain the matter has been taken further, and Smith and Markham[3] describe how the island of Islay off the coast of Scotland is being used for raising virus-free potatoes. Similar isolation is the object of the Riet River scheme; but the scheme goes further and aims not just at producing seed free from every known potato virus, but at supplying it in such quantity that it meets the ordinary demands for good seed. For South Africa, small as its potato industry is, these are put at about five thousand tons a year, or more.

The idea is to have a reserve of sufficient size from which all viruses are excluded. In such a reserve the growers would have a multifold advantage. They would get the highest quality at less cost, partly because they would not be burdened with practices like the removal of infected plants, and partly because yields would reflect the absence of virus *X* and other infections which depress productivity. In an isolated reserve freedom from virus can be made its own reward, and virus-free seed can be produced not as a speciality, but in bulk and more efficiently than ordinary seed is grown at present. That is the essence of the matter.

The decision to grow virus-free seed at the Riet River Settlement was made several years ago. The area has many advantages. It is well isolated. Disease-carrying aphids are scarce in its hot, dry climate[5]. Experience with the ordinary grade of seed grown there showed that in quality and productivity it equalled anything planted in the Union[6], Scottish and Irish seed not excepted.

To maintain adequate isolation, regulations made under the Act already mentioned are being used to prohibit the entry of all unauthorized potatoes. For safety's sake, all land within ten miles of the Settlement has been added to the reserve, but few potatoes are likely to be grown there. Outside this boundary (except for an irrigable strip higher up the Riet River which may still be proclaimed) is dry grazing country, too dry for crop farming. Potatoes are planted only in scattered kitchen gardens under irrigation, and then only rarely. The nearest point at which they are grown on any scale worth mentioning is about forty miles away, while there is no intensive potato culture anywhere within a hundred miles. Isolation of this sort will, it is hoped, stop the infiltration of virus into the reserve; but to allow for the chance of occasional introductions the State will continue to grow a small acreage of tested seed which will be used for the frequent renewal of settlers' stocks.

A stock has been built up sufficient to produce the first thousand tons of seed within the next year. So far as one can test, this is free from all potato virus diseases, except leaf-roll, which is present in small amounts. Completely virus-free seed will, it is hoped, be available in bulk a year later.

It is too early to say how far seed production on this type of country can be extended. A full answer must wait until the Settlement's five thousand acres of suitable land are occupied after the War. But there is enough evidence for a preliminary assessment of the position. To the plant pathologist the prospects are favourable. Apart from virus diseases, the climate completely controls *Phytophthora* blight, black leg and powdery scab—to name only tuber-borne infections—and to judge from results in Kansas[7] gives an easy method of controlling *Rhizoctonia*. Diseases more suited to the climate may still appear, but there is no evidence of them yet. For the agronomist the issues are less favourably balanced, and it is on him that future expansion really rests. The climate has its virtues. One might mention particularly the remarkable speed of tuber formation which allows main-crop, varieties to set a good yield of seed-sized potatoes within six weeks of emergence, and which may probably be attributed to the intense radiation during the fairly short days, and to the great contrast in temperature between day and night. Against this are various cultural difficulties, especially those associated with the high temperature of the soil through which the shoot must emerge. While they have not stopped the rapid building-up of seed stocks in the past, they remain a danger which cannot safely be ignored, and on their solution hangs the possibility of eventually bringing into use the practically limitless area of suitable climate.

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[1] Proclamation 4, 1945, S. African Govt. Gazette, Jan. 9, 1945.
[2] Bald, J. G., Council for Sci. and Indust. Res. (Australia). Bull. 165 (1943).
[3] Smith, K. M., and Markham, R., *Nature*, 155, 38 (1945).
[4] Bald, J. G., *J. Council Sci. and Indust. Res.*, (Australia), 17, 258 (1944).
[5] *Nature*, 153, 589 (1944).
[6] For a farmer's opinion of seed from the sister settlement at Vaal Harts, seventy miles away in a similar climate, see (S. African) *Farmer's Weekly*, 58, 1284 (1945).
[7] Elmer, O. H., *Phytopath.*, 32, 972 (1942).

Swimming of *Monas stigmatica*

WHILE not disputing the relatively high speed attained by this organism[1], exception must be taken to Mr. A. G. Lowndes' statement "thus the organism has a relative speed of more than forty, or, in other words, traverses forty times its own length in a second, and on this simple calculation the organism has a relative speed which is twice that of the most modern 'Spitfire' and a thousand times that of a modern destroyer". The figure for a destroyer is nearer two hundred in lieu of one thousand. Moreover, the 'length', for the purpose of such a comparison, should be a dimension in the same plane as the direction of motion.

As this is essentially a hydrodynamic comparison, the well-known law of corresponding speeds should be applied : the correct criterion being speed divided by the square root of the length, and not speed divided by the length as Mr. Lowndes states.

The organism as described is a screw propeller, rather than a hull. That being so, the most important criterion is the relative speed of rotation. This, by the law of corresponding speeds, is the number of revolutions per unit time, *multiplied* by the square root of the diameter. If Mr. Lowndes can measure the revolutions per second of the organism, it would be extremely interesting to compare its *relative* rotational speed with that of a 'Spitfire' airscrew or a destroyer propeller.

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[1] *Nature*, 155, 579 (1945).

DR. TUTIN is a member of the Institution of Naval Architects, and I accept his statement that the relative speed of *Monas stigmatica* is only about two hundred times that of a modern destroyer. In the past, the relative speed of living organisms has always been expressed as the ratio *distance per sec./length of organism*[1]. It would indeed be interesting if one could measure the revolutions per sec. of the organism ; but I fear this is impossible at present, since it could only be done either by the use of high-speed photomicrography or by the use of the stroboscope attached to the microscope.

A camera giving 1,200 exposures per sec., each exposure of the order of 1/50,000 sec., is normally available here and the cost of film is only about 6*d*. per sec.[2]. Unfortunately, owing to the small size of the organisms, high powers of the microscope are essential and this means confining the organisms within a small space and subjecting them to an intense illumination. Under these conditions the swimming of these organisms is quite abnormal, and they usually stop swimming altogether. This being so, neither the film nor the stroboscope would mean anything.

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[1] Tabulæ Biologicæ, 4, 478.
[2] Lowndes, A. G., "The Twin Polygraph and Strobograph", *Nature*. 135, 1006 (1935).

Scientific Material in Occupied Europe

MANY people have been perturbed by reports that the Nazis had applied to scientific material the same process of spoliation and confiscation that they had carried out so systematically in the realm of art. For example, on the liberation of southern Holland, it was reported that the Wasmann collection of ants had been forcibly removed from Maastricht to Berlin.

Recently, however, I have received a letter from Dr. Wilhelmina van de Geijn, of the Maastricht Museum, which indicates that in this case the loss has not been so severe as was first feared, thanks to her courage and presence of mind. Readers of *Nature* will be interested to have her account of the incident.

She says (*in lit.*, May 6, 1945), "A Berlin entomologic professor, Bisschof, had shown very much interest in our Museum because of the well-known ant collection of Wasmann, which they took or stole and brought it to Berlin. You can read the history in the cutting ("Time" 20 Nov. 1944). He threatened me 'Ich werde Sie sofort einsperren', because I refused to tell him where I had hidden the collection ; after some discussion with the Nazi mayor they show him the ants. I had some exciting weeks, because I divided the collection and they did not notice it here, but I was afraid that the professor would pay more attention in Berlin—fortunately I never heard anything."

Reports from Belgium and Holland now coming through fortunately suggest that the theft of the Wasmann collection was the act of an individual bully rather than part of a scheme of systematic spoliation.

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SOCIETY FOR GENERAL MICROBIOLOGY

THE proceedings of the inaugural meeting of this Society have been reported in *Nature* of March 17, 1945, p. 340, together with a brief summary of the address then given by the Society's first president, Sir Alexander Fleming. It is now possible to add some notes on the contents of the interesting papers read at the inaugural meeting.

In the first place, one point in Sir Alexander Fleming's address not previously mentioned will no doubt interest many research workers. Sir Alexander pointed out that team-work is not always an advantage. If, he said, he had been, in 1928, one of a team studying variation in staphylococci, he would, when a mould contaminated one of his culture plates, have "played for the side" and would have gone with the staphylococci, instead of following up the side track which led, by devious paths, to penicillin. "The lone hand has," he said, "advantages as well as the much-advertised team-work, but each in its own place."

There are many who will agree with this. Team-work can be over-emphasized, and better results, outside the field of 'applied' research at any rate, may come from the looser associations between individuals working in the closely inter-related laboratories of different branches of science in residential universities. These are teams with a difference, and perhaps the difference is often vital to discovery. It could, indeed, be argued that, if we had more residential universities of moderate size, fewer scientific societies would be required and more discovery would result. If teams were needed for organized attacks upon selected problems, these could then be the more easily recruited from groups of men who would work better together because they always had been working together and knew each other's strengths and limitations.

The importance of the constant intercourse of individuals provided by a residential university cannot be over-estimated. It was, in fact, brought out by Dr. Marjory Stephenson in her paper on "Levels of Microbiological Investigation". As knowledge increases, she said, and technique becomes more difficult, interdepartmental collaboration is "strongly indicated". Workers must be refreshed by contacts with work at other levels, and she gave a table illustrating the levels to which she referred. None of these, she insisted, is to be regarded as higher or lower than any of the others. At level *A*, represented by the early Pasteur period from 1858 onwards, and by modern work on marine, river and lake populations, on ruminant digestion and the soil, mixed cultures of organisms growing in natural environments are used. At level *B*, represented by the later Pasteur period from 1876 onwards, pure growing cultures of organisms in laboratory media are used. To this level belong the great triumphs of medical bacteriology, which resulted in the isolation in pure culture and identification of causal agents of infectious diseases, specific fermentation and chemical changes in the soil. Most medical and epidemiological bacteriology is still done at this level and almost every modern discovery must begin here ; but this technique cannot reveal the mechanism by which the effects of a given organism revealed by it are brought about. At level *C*, dating from 1919 onwards, the substrate is simplified and a beginning is made with the study of the mechanisms by which an organism in pure culture produces its chemical effects. Non-proliferating cells in pure culture on chemically defined substrates are used. This method gave us the early studies on intermediary processes of fermentation, on the use of poisons, inhibitors and fixatives, and also the early studies on oxidation, reduction, deamination and so on. At level *D*, dating from 1930 onwards, pure growing cultures in highly purified media are used ; this level has given us detailed studies of growth requirements, nutritional needs, chemotherapy and microbiological assay. At level *E*, beginning in 1940, cell-free enzymes and co-enzymes in pure substrates are employed. It is a development of level *C* ; but the enzymes are separated and it is shown how each produces its effect on its own particular substrate. Greater precision is provided in our knowledge of fermentation processes and correlation with the chemical activity of animal and plant tissues. It is not confined to filterable enzymes. Enzymes can now be extracted from the bacterial cell itself (for example, from *Bact. coli*), and study and work of this latter kind is nowadays gathering momentum and volume.

These levels represent different methods of technical approach. The workers at each level are dependent upon each other, because facts established at levels *A* and *B* provide the starting-point for work at levels *C*, *D* and *E* ; and results obtained at levels dealing with enzymes must be referred back to level *B* for epidemiological verification and animal experiment. Incidentally, Dr. Stephenson put in a plea, which many will support, for the abolition of the terms 'fundamental' and 'pure' science.

Mr. F. C. Bawden, discussing plant viruses, reminded the Society that viruses were discovered by the breakdown of bacteriological techniques, namely, by the discovery that an apparently sterile filtrate was infectious. The chief techniques of the bacteriologist are therefore not suited to the study of viruses. The protein chemist provides the most useful new techniques. Several viruses have been obtained from nucleoproteins and some are fundamentally different from organisms ; chemically they are less complex and their internal structure is much less regular than that of the simplest known organisms. In their purified state they resemble constituent parts of organisms rather than whole organisms, and we may ultimately have to deal with them as such. They are favourable material for the study of mutations and multiplication, and they are attractive subjects for the protein chemist. Plant viruses provide excellent antigens for serological studies ; they readily produce antibodies when they are put into animals. The study of viruses brings together workers in widely separated fields.

Prof. W. B. Brierley used the grey mould, *Botrytis cinerea*, to illustrate his discussion of problems presented by the micro-fungi. The morphology of these organisms is no guide to their physiology, for two individuals may look alike and bear the same name (for example, *B. cinerea*) and yet show very wide difference in behaviour. The unit of behaviour is the experimentalists' strain of the organism. Discussing the value of morphological, cultural and physiological criteria for the delimitation and characterization of species, varieties and strains, and the genetic and taxonomic relationships of these categories in the light of variation in the microfungi, Prof. Brierley concluded that we urgently need genetic and behaviouristic study which aims at systematic grouping on a cultural and behaviouristic basis at the level of the strain.

The importance of the general theme discussed by

Prof. Brierley is underlined by the trend of discovery in more than one field of biological research. In helminthology, for example, the existence of what are called 'physiological strains' of certain species of helminths which are morphologically indistinguishable has long been known. Epidemiologically these strains are often very important. Thus it is not possible to distinguish structurally *Ascaris lumbricoides* of the pig from *A. lumbricoides* of man; yet, when Koino infected himself with *A. lumbricoides* of the pig, he suffered only respiratory symptoms due to the migration of the larvæ to his lungs, and the strain was unable to develop to the adult stage in his intestine. It has been claimed, conversely, that the human strain of *A. lumbricoides* will not develop to the adult stage in the pig, although it may do so provided that the experimental pig's resistance is lowered by a diet deficient in vitamin A. Similar physiological strains of the sheep stomach worm, *Hæmonchus contortus*, and the gapeworm *Syngamus trachea* of poultry have also been recognized.

This subject was further discussed in the paper given to the Microbiological Society by Dr. Cecil A. Hoare, who described the morphologically identical but biologically different strains of certain Protozoa. Because many of these strains exist among the blood-inhabiting Protozoa, their host-relationships are important from several points of view. Some strains differ from each other in their host specificity; others cause different diseases in the same host; others vary in their degree of virulence to the host. These biological groups include both races which are stable and hereditarily fixed and strains which are environmentally induced and unstable, the latter being comparable to the so-called 'enduring modifications' or *Dauermodifikationen*. Biological races of Protozoa are equivalent to the 'types' recognized among the bacteria. The available data indicate that in both instances the differences between the groups in question are determined by the same factors, namely, by variation in antigenic composition. In both Protozoa and Bacteria, therefore, the distinction between biological races resolves itself into differences in the chemical constitution of their antigens. Dr. Hoare directed attention to the unsatisfactory nature of the nomenclature used for biological groups in general, and suggested that biological races should be assigned to an independent systematic position, representing a taxonomic unit subordinate in rank to species or subspecies. With this most parasitologists, at any rate, will agree. Some such measure is indeed being forced upon them by the epidemiological and other consequences of modern work on the host-parasite relationships of many kinds of parasites. No doubt the necessity for it will be even clearer and the scientific basis for it will be provided when improvements in the technique of the cultivation of metazoan parasites makes possible work at the levels *D* and *E* indicated by Dr. Stephenson.

Prof. R. H. Hopkins, discussing yeasts, pointed out that the chemist's conception of yeasts as unicellular budding organisms which produce alcoholic fermentation of certain sugars does not coincide with either the 'true yeasts' or the 'yeast-like fungi' of the mycologist. Earlier classifications of the yeasts are likely to be replaced by a classification based upon genetic work. The introduction of a synthetic medium will at least remove discrepancies due to the variable composition of media upon which yeasts are grown. Discussing recent genetic work, Prof. Hopkins suggested that from it we may expect not only a new and sound system of classification, but also perhaps improved yeasts, for industrial purposes, produced by planned breeding. While the breeding of hybrids is confined to spore-forming yeasts, new yeast types may result from mutations induced by irradiation, toxic chemical agents, such as lithium chloride, cyanides and camphor, and other means, and these methods should be applicable to non-sporing yeasts also. Among examples of this kind of work given by Prof. Hopkins was Thaysen's production of *Torulopsis utilis* var. *major* by the use of camphor (*Nature*, **152**, 526; 1943).

Dr. A. T. R. Mattick discussed some basic problems of dairy bacteriology. One of these is the resistance of bacteria to heat, which is intimately connected with the sterilization of milk equipment and with pasteurization. Cheese-making provides the problem of the lactic streptococci which are normally added to milk to produce the lactic acid necessary for the optimum coagulation due to rennet; but these streptococci produce, if they are heated above the normal cultivation temperature of 22° C., large quantities of acetic acid; and at lower temperatures other products appear. The practical importance of bacteriophage in cheese-making is considerable, for bacteriophage freely attacks the lactic streptococci used, and strains of streptococci insusceptible to local bacteriophages are needed. Dr. Mattick also described the steps by which he and Mr. A. Hirsch (see also *Nature*, **154**, 551; 1944) developed the work of Whitehead in New Zealand on the substance or substances recoverable from milk which inhibit the growth of streptococci used to start the production of acid. Mattick and Hirsch found that this inhibitory substance inhibits also, both *in vitro* and *in vivo*, the growth of some streptococci which are pathogenic to man and also that of certain acid-fast bacteria, including *Mycobacterium tuberculosis*. It is possible that this substance may be useful for the control of bovine mastitis. The work being done at the London School of Tropical Medicine upon what is apparently the same substance has already been noted in *Nature* (**155**, 584; 1945). In cheese-making, said Dr. Mattick, the moulds are also important, for they are used to ripen some of our choicest cheeses. Thus *Penicillium roquefortii* ripens Stilton cheese, but the strain used makes "a world of difference to the flavour".

Dr. G. H. Wooldridge, discussing the relationship of veterinary science and microbiology, said that veterinary science has gained much from the work of microbiology and has also contributed its share to our knowledge of microbiology. He gave many examples of outstanding work by veterinarians. To them we owe much of our knowledge of anthrax, tuberculosis, glanders, rabies, foot and mouth disease, braxy, rinderpest, the diseases of sheep caused by anærobic bacteria and other diseases which may profoundly affect human civilization. The discovery made by Griffith Evans in 1850 that surra is due to a trypanosome was the forerunner of the work of Bruce, a medical man, on nagana, a disease of horses due to a trypanosome; and Bruce applied that work to the study of human trypanosomiasis. Co-operation between the medical man Theobald-Smith and the veterinarian Kilburn in the United States discovered that red water fever in cattle is due to a piroplasm transmitted by a tick. Veterinary workers should study more intensively the host-parasite relationship and the control of the spread of disease.

U.S. NATIONAL PATENT PLANNING COMMISSION: SECOND REPORT

IN its first report on the American patent system, the National Patent Planning Commission directed attention to certain aspects of the general operation of the patent laws. The present report* deals with the administration of patents that have come to be owned outright by the Government and also with the respective rights of the Government and its employees and contractors in inventions evolved during the employment or contractual relationship.

On the matter of government-owned patents, the Commission recommends that the Government should "as a general rule continue to pursue the historic policy of not exercising the right to exclude conferred by patents which it owns; of not attempting to exclude its own citizens from engaging in any enterprise; of not seeking to derive revenue from patents, and of not undertaking control by means of patents. Inventions covered by patents owned by the Government should be available for commercial and industrial exploitation by anyone, with, however, the recourse open to the Government to take different action in exceptional cases". In recommending the Government to continue to follow this historic policy and to make inventions covered by Government-owned patents available for exploitation by anyone, the Commission recognizes that there are many patents on inventions developed by, or for, the Government that would be of great public benefit if they were commercially exploited. What prevents such inventions from being commercially exploited, however, is that manufacturers are generally unwilling to make substantial investments in commercializing them if they are also available to competitors. The Commission therefore recommends that suitable legislation should be enacted to confer on the Government the power to grant exclusive licences or to assign Government-owned patents "under appropriate conditions and safeguards whenever it is determined that such action is necessary to assure the commercial development of an invention of a Government-owned patent".

On the policy to be followed regarding the respective rights in employee inventions, the Commission finds that Government policy has not been uniform; but, even so, recommends that it should not be governed by rigid rules prescribed in advance for all departments and all cases. The opinion is expressed that it should be a matter primarily for departmental treatment and in the two extreme cases, first, when an employee is employed to invent and, secondly, when an employee makes an unrelated invention by use of his own time and facilities, the rule of the general law should be followed. In departments confronted with substantial patent problems, general regulations should be maintained or promulgated.

In the report it is stated that a considerable amount of governmentally subsidized research in connexion with the War is being conducted by educational institutions and by private concerns under Government contracts, and that patent rights resulting from such research have been disposed of in various ways. A common feature of these ways is a contractual clause by which the Government has the option of obtaining licences on reasonable terms; but the Commission expresses the opinion that a uniform patent clause is unfeasible and undesirable, and that each case should be decided in accordance with the facts involved.

In order to correlate the patent policies and practices of the various Government agencies, the Commission recommends that there should be established a central control body, in the Executive Office of the President, having the following principal powers, functions and duties:

(*a*) Promulgating general policies and supervising and approving departmental policies regarding employee inventions, and determining disputed cases.

(*b*) Supervising and approving the manner of disposing of patent rights by the individual departments, including granting exclusive licences and selling Government-owned patents.

(*c*) Instructing and advising departments and agencies, collecting information, conducting investigations, and making appropriate recommendations.

In commenting in *Nature* (**153**, 12; 1944) on the First Report of the National Patent Planning Commission, it was pointed out that the numerous important technical changes recommended by the Commission were almost uniformly such as to bring the American patent system more closely into accord with that of Great Britain; the same comment is applicable to the present report. The British Government, acting through the Department of Scientific and Industrial Research and the Imperial Trust for Encouragement of Industrial Research, possesses power, which the Commission recommends should be conferred on the Government of the United States, to assign or to license patents owned by it. Further, the procedure suggested by the Commission for dealing with employee inventions is in close agreement with the procedure established many years ago in Britain as a result of the report of the Inter-Departmental Committee on Patents presided over by Sir Kenneth Lee.

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* Government-owned Patents and Inventions of Government Employees and Contractors. Second Report of the National Patent Planning Commission. Pp. 27. (Washington, D.C., 1944.)

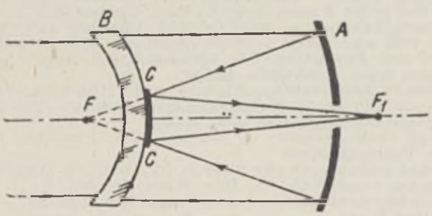
THE MENISCUS TELESCOPE

IN the Soviet Union at the present time, a novel system of telescope construction is engaging the interest of astronomers and those concerned with the erection of telescopes, whether for research observatories or for instructional purposes in schools. The system, called the meniscus catadioptric system, was worked out in 1941 by Dr. D. D. Maksutov, of the State Optical Institute. The principles involved and the advantages to be derived therefrom have been described by Dr. Maksutov in an article[1] which appeared recently in the journal *Nauka i Zhizn*, published by the Academy of Sciences of the U.S.S.R.

In its simplest form, the optical system of a meniscus telescope comprises a single thick meniscus lens, with spherical surfaces concave to incident light, which is placed some distance in front of a concave, silvered or aluminized, spherical mirror. The meniscus is a diverging lens of exceedingly low power but it produces appreciable spherical aberration. Parallel rays, for example, from a star, falling upon the meniscus, remain nearly parallel after transmission and are reflected back by the mirror to form an image between the mirror and the meniscus.

Spherical aberration is produced both by the meniscus and the mirror; but one is positive and the other is negative. It is this fact which is the basis upon which the theory and the design of the meniscus telescope have been built. Maksutov has succeeded in proving that by suitable selection of the radii of curvature of the meniscus and mirror, the thickness of the meniscus and the quality of the glass used, it is possible to arrange that the spherical aberration of the mirror is compensated for by the spherical aberration of the meniscus lens. In addition, the design permits the almost complete removal of chromatism. By these means, sharpness of image in the centre of the field of view is readily attainable; but Maksutov has also shown that it is only necessary to introduce into the calculation the distance between the meniscus and the mirror to establish the conditions for a field of view which will be well defined over an area sufficiently great for all practical purposes.

The principle may be used in various types of more complex telescopes. The accompanying figure illustrates one such type. Here the meniscus and mirror are placed closer together than is usual in the simplest type, and the centre portion of the meniscus is silvered so that the reflected rays from the concave mirror fall on the meniscus, are reflected by the small convex mirror, pass through an opening in the concave mirror and form the image.



A meniscus telescope combines most of the good qualities of both refractors and reflectors and eliminates most of the unsatisfactory features. It is extremely compact and powerful; it is generally of closed construction, like a refractor, and it is achromatic, like a reflector. Moreover, it is of great significance, from the point of view of simplicity and cheapness of manufacture, that all the optical elements are parts of spherical surfaces.

The superiority of the meniscus type over the other two main types of telescopes used for astronomical purposes may be illustrated by taking as examples, the Yerkes refractor, the Simeiz reflector and one of the meniscus telescopes now planned for construction in the U.S.S.R. These examples are comparable since the aperture in each case is 1 m. approximately. The Yerkes refractor has a tube-length of 20 m., and the object-glass consists of two lenses of optical glass (crown and flint), but in spite of the great length, the quality of the image obtained is very poor on account of chromatic aberration. The Simeiz reflector (now destroyed) had a parabolic mirror of 1 m. diameter and its tube-length was about 5 m. The image quality at the centre of the field of view was faultless, but it deteriorated rapidly towards the edges. The meniscus telescope referred to will have a tube-length of a little less than 3 m. The image is expected to be sharp over a fairly wide field, while the power will be considerably greater than that of a reflector of similar diameter. It will require only one lens in optical glass. Crown glass or flint glass or, indeed, almost any type of glass, could be used; but crown glass has naturally been chosen since it is more transparent to violet and ultra-violet light.

Because of the reduction in size the cost of building observatory domes, etc., will be much less with meniscus telescopes than with other types. It is estimated that the Simeiz type and the Yerkes type would cost four times and seventy times, respectively, the amount which will be expended on a 1 m. diameter meniscus telescope.

Many observatories, together with their equipment and instruments, have been destroyed during the War, but Soviet astronomers are determined on the speedy restoration of these and the construction of new observatories where instruments, embodying all the refinements of recent research, will rival the best available elsewhere. They are planning, also, an increase in the number and size of university observatories, and they are proposing to establish smaller telescopes in both town and country schools. The meniscus type of telescope offers the best means of achieving these aims with the minimum of delay and the minimum of expense.

G. STANLEY SMITH.

[1] Maksutov, D. D., *Nauka i Zhizn* (*Science and Life*), No. 9, p. 1 (1944). The theory is described in detail and dimensional particulars are given under the reference: Maksutov, D. D., *J. Opt. Soc. Amer.*, 34, 270 (1944).

RECENT WORK ON RHENIUM

IN the two decades since rhenium (Mendeléeff's dwi-manganese) was discovered, hundreds of its compounds have been reported. Among the latest are some stable complexes in which the element is present as the cation. Lebedinský and Ivanov-Emin (*J. Gen. Chem.*, *U.S.S.R.*, 13, 253; 1943) have described the complexes derived from saturated solutions of the double chlorides, K_3ReCl_6 and K_2ReCl_6, by using a large excess of ethylene diamine. This is apparently the only suitable base, since ammonia and pyridine do not react in the same way. During the reaction, rhenium oxidizes to the pentavalent state and $ReO_2(C_2H_4N_2H_4)_2Cl$ separates. It gives no precipitates in aqueous solution except with cobaltinitrites and platinichlorides.

A corresponding iodide, only slightly soluble in water, was obtained by metathesis with potassium iodide. When treated with hydrochloric acid the substances yield $ReO(OH)(C_2H_4N_2H_4)_2Cl_2$, which is isolated from its saturated solutions by precipitation with alcohol. A curious compound, $ReO(OH)(C_2H_4N_2H_4)_2PtCl_6$, results when the chloride is mixed with sodium platinichloride solution. A corresponding iodide is also known. Both are only slightly soluble in water, but the solutions contain rhenium ions.

When rhenium salts were first obtained there was some controversy over the efficacy of hydrogen sulphide as a reagent for precipitating rhenium as sulphide. Geilmann and Lange (*Z. anal. Chem.*, 126, 321; 1944) now state that the heptasulphide is completely precipitated from slightly acid solutions by hydrogen sulphide under pressure, especially if the mixture is heated for half an hour before filtering. For estimating rhenium the washed precipitate is converted into sodium per-rhenate with sodium hydroxide and perhydrol and then re-precipitated as nitron per-rhenate. Rhenium compounds fused with sodium carbonate and sulphur yield an insoluble alkali complex.

Another selective reagent, toluene-3 : 4-dithiol, is found to give a green complex with rhenium (and also with molybdenum) and a blue one with tungsten (Miller, *Analyst*, 69, 112 ; 1944). The K-absorption limit for rhenium is reported to be 172·66 by Manescu (*C.R. Acad. Sci.*, **216**, 732 ; 1943) who examined its salts between 'Cellophane' sheets using a potential of 100–125 kV.

According to Naray-Szabo, rhenium trioxide crystals are cubic (*Naturw.*, 31, 466 ; 1943).

FORTHCOMING EVENTS

Saturday, June 30

ASSOCIATION FOR SCIENTIFIC PHOTOGRAPHY (at the Alliance Hall, Westminster, London, S.W.1), at 2.30 p.m.—Mr. H. White : "Make the Photograph tell a Story".

Friday, July 6

PHYSICAL SOCIETY (at the Royal Institution, Albemarle Street, London, W.1), at 5 p.m.—Prof. Arturo Duperier : "The Geophysical Aspect of Cosmic Rays" (29th Guthrie Lecture) (Fellows of the Royal Astronomical Society and members of the Royal Meteorological Society are also invited to attend).

Saturday, July 7

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (at the Rothamsted Experimental Station, Harpenden), at 9.30 a.m.—Fiftieth Annual Congress. Prof. W. G. Ogg : "Some Aspects of the Work at Rothamsted".

INSTITUTE OF PHYSICS (LONDON AND HOME COUNTIES' BRANCH) (in the Physics Department, Imperial College of Science and Technology, South Kensington, London, S.W.7), at 2 p.m.—Discussion on "The Corrosion of Metals".

APPOINTMENTS VACANT

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

CIVIL ENGINEER by the British Overseas Airway Corporation, for control and supervision of civil engineering and building work in the India and Burma Region—The Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2, quoting E.1659.XA (July 6).

LECTURER (full-time) IN ELECTRICAL ENGINEERING—The Principal, Handsworth Technical College, Golds Hill Road, Birmingham, 21 (July 7).

LECTURER-IN-CHARGE OF THE CHEMISTRY DEPARTMENT EVENING CLASSES in the East Ham Technical College, to be responsible for organization and development of part-time courses up to Higher National Certificate standard and courses in both Pure and Applied Chemistry—The Chief Education Officer, Education Office, Town Hall Annexe, Barking Road, East Ham, London, E.6 (July 7).

ASSISTANT LECTURERS IN BOTANY, GEOGRAPHY (climatology and cartography), and ZOOLOGY—The Registrar, University College, Exeter (July 9).

BOROUGH ELECTRICAL ENGINEER AND MANAGER—The Town Clerk, Town Hall, Leigh, Lancashire (endorsed 'Borough Electrical Engineer and Manager') (July 10).

WATER ENGINEER AND MANAGER—The Town Clerk, Council Offices, North Street, Chichester, Sussex (endorsed 'Appointment of Water Engineer') (July 11).

DIRECTOR OF WORKS by a Governmental Office (candidates must be Corporate Members of the Institution of Civil Engineers and must have had experience in carrying out constructional work abroad)—The Ministry of Labour and National Service, Appointments Department A.9, Room 5/17, Sardinia Street, Kingsway, London, W.C.2, quoting E.1700.A (July 13).

ASSISTANT ADVISER IN PLANT PATHOLOGY—Prof. R. G. White, School of Agriculture, University College of North Wales, Bangor (July 14).

DEMONSTRATOR IN THE PHYSICS DEPARTMENT, for general teaching duties—The Dean, Guy's Hospital Medical School, London Bridge, London, S.E.1 (July 14).

LECTURER IN PHYSICS—The Principal, Royal Holloway College, Englefield Green, Surrey (July 14).

GARDENING INSTRUCTRESS for a County Technical School for Girls with a demonstration garden at Chislehurst—The County Education Officer, Springfield, Maidstone (July 14).

ASSISTANT LECTURER IN CHEMISTRY, and an ASSISTANT LECTURER IN CLOTH MANUFACTURE, at the Bradford Technical College—The Director of Education, Town Hall, Bradford (July 14).

ASSISTANT LIBRARIAN in the University Library, and a SUB-LIBRARIAN in the Faculty of Engineering—The Registrar, The University, Liverpool (July 15).

PROFESSOR OF CHEMICAL TECHNOLOGY at the University of Madras—The Registrar, University of Madras, Chepauk, Triplicane, Madras (by Air, July 15 ; copy to the High Commissioner for India, General Department, India House, Aldwych, London, W.C.2).

LIBRARIAN—The Secretary, The University, 38 North Bailey, Durham (July 16).

ASSISTANT LECTURER IN HORTICULTURE with special qualifications in Horticultural Machinery—The Registrar, The University, Reading (July 16).

RESEARCH OFFICER FOR SPECTROSCOPIC INVESTIGATIONS, Division of Industrial Chemistry, Council for Scientific and Industrial Research, Melbourne—The Secretary, Australian Scientific Research Liaison Office, Australia House, Strand, London, W.C.2 (July 16).

LECTURER IN GEOGRAPHY (with special qualifications in Cartography)—The Registrar, The University, Reading (July 16).

LECTURER (or ASSISTANT LECTURER, according to qualifications) IN THE DEPARTMENT OF BOTANY—The Secretary, King's College, Strand, London, W.C.2 (July 20).

SECOND ASSISTANT PETROLEUM TECHNOLOGIST in Trinidad—The Ministry of Labour and National Service, Appointments Department A.9, Room 5/17, Sardinia Street, Kingsway, London, W.C.2, quoting F.4411.A (July 21).

SCIENTIFIC ASSISTANT—The Deputy Director, Imperial Bureau of Dairy Science, Shinfield, Reading, Berks (July 21).

UNIVERSITY LECTURER IN GEOLOGY—The Secretary of the Appointments Committee of the Faculty of Geography and Geology, Department of Mineralogy and Petrology, Cambridge (July 30).

SECRETARY TO THE UNIVERSITY COUNCIL—The Secretary, University Registry, Cathays Park, Cardiff (July 31).

LECTURESHIP IN CHEMISTRY—The Registrar, Trinity College, Dublin (August 20).

WARDEN OF CREWE HALL (the University Hall of Residence for Men) who must be a graduate and will be required to take some part in University teaching—The Registrar, The University, Sheffield (August 31).

CHAIR OF MEDICINE in the University—The Registrar, The University, Sheffield (October 31).

CHAIR OF SURGERY tenable at the British Postgraduate Medical School—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (January 1).

LECTURER IN CHEMISTRY, with qualifications in Organic Chemistry—The Registrar, University College, Exeter.

LABORATORY ASSISTANT (man or woman) FOR THE BIOLOGY DEPARTMENT—The Warden and Secretary, London (Royal Free Hospital) School of Medicine for Women, 8 Hunter Street, London, W.C.1.

LABORATORY APPRENTICES (boys or girls) IN THE DEPARTMENTS OF BOTANY, PHYSICS, PHYSIOLOGY AND ZOOLOGY—The Secretary, Bedford College for Women, Regent's Park, London, N.W.1.

RESEARCH MANAGER, a CHIEF CHEMIST, CHEMISTS and PHYSICISTS (2 or 3) with some years research experience, and several JUNIOR CHEMISTS and PHYSICISTS—The Director, Paint Research Station, Waldegrave Road, Teddington, Middx.

TEACHER IN ENGINEERING SUBJECTS up to Higher National Certificate standard in day, part-time, and evening classes—The Principal, Erith Technical College, Belvedere, Kent.

TEACHER (well qualified) OF SCIENCE—The Principal, Technical Institute, Tunbridge Wells.

LECTURER (full-time) IN THE PHYSICS DEPARTMENT—The Secretary, Northampton Polytechnic, St. John Street, London, E.C.1.

HEAD OF THE ENGINEERING DEPARTMENT—The Registrar, Municipal College, Portsmouth.

TEACHER (full-time, day and evening) OF ENGINEERING SUBJECTS in the Harrogate Technical Institute—W. E. C. Jalland, Municipal Offices, Harrogate.

TEACHER OF ENGINEERING SUBJECTS, including Workshop Practice and Drawing, and a TEACHER OF ELECTRICAL ENGINEERING SUBJECTS in Day and Evening Classes, in the Mexborough Schofield Technical College—E. B. Stockdale, Education Office, Mexborough, Yorks.

ASSISTANT LECTURER IN AGRICULTURE, and an ASSISTANT LECTURER IN AGRICULTURAL BOTANY—The Registrar, University College of Wales, Aberystwyth.

LECTURERS (full-time) IN GENERAL ENGINEERING SUBJECTS to Higher National Certificate standard, ELECTRICAL SUBJECTS to University Degree standard, and PHILOSOPHY (candidates should possess a good Degree in Philosophy or Psychology and be able to take a class in Elementary Logic)—The Clerk to the Governors, South-West Essex Technical College and School of Art, Forest Road, Walthamstow, London, E.17.

TEACHER (well qualified) OF MECHANICAL ENGINEERING, and a TEACHER (well qualified) OF ELECTRICAL ENGINEERING—The Principal, Technical Institute, Darnley Road, Gravesend.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Association for Planning and Regional Reconstruction. Review No. 5 (A.5) : Resources of the Sea. Pp. 41. (London : Association for Planning and Regional Reconstruction, 1945.) [26

Imperial Bureau of Pastures and Forage Crops. Bulletin No. 33 : Ley Farming in Sweden ; a Field Day at Svalof. Pp. 44. (Aberystwyth : Imperial Agricultural Bureaux, 1945.) 3s. [26

Proceedings of the Science (Research) Society. No. 3 : Report of the Biological Panel. Pp. 22. (Richmond : Science (Research) Society, 1945.) 1s. [26

National Institute for Research in Dairying. Report for the Three Years 1941, 1942 and 1943. Pp. x+68. (Shinfield : National Institute for Research in Dairying, 1945.) [26

U.S. Office of War Information. Symposium on Recent Advances in Medicine. Pp. vi+260. Symposium on Recent Advances in Surgery. Pp. vi+229. (Reprints from the Medical Clinics of North America for 1944.) (London : U.S. Office of War Information, 1944.) [26

Catalogue

Brochure of Mass Miniature Radiography. Pp. 34. (London : Watson and Sons (Electro-Medical), Ltd., 1945.)