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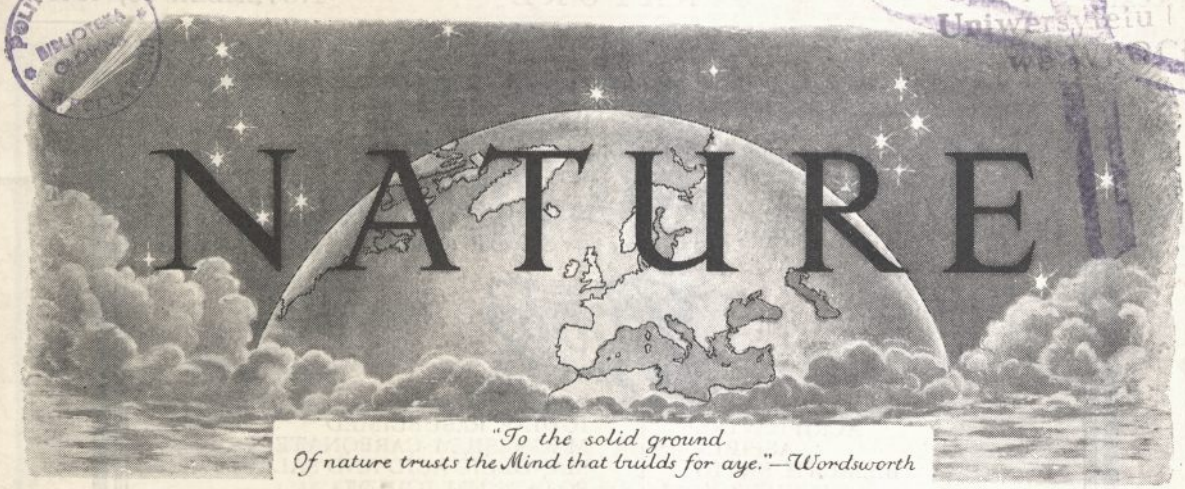

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EDUCATION FOR THE FUTURE

IN his chapter on "Science and Free Culture" in his recent volume "Freedom and Culture", Dr. Dewey emphasizes the importance of developing the scientific outlook throughout a democracy, and not merely concerning ourselves in the general teaching of science with the dissemination of facts in particular branches of science. This attitude is a vital safeguard against wholesale misleading by propaganda, and is essential if science is to exert its real cultural effect.

The importance of this in education is very far from being realized, but Dr. Dewey is undoubtedly right in his firm warning about the dangers of any educational system in a democracy in which what is taught and how it is taught is not determined upon the basis of the formation of the scientific attitude. Unfortunately, there is little evidence that its significance has been realized in the various renewed attempts to deal with war-time problems of education which have recently been made. The Haining Committee appointed early this year to recommend how education could play its part in the welfare arrangements required during the coming winter does not appear to have paid any particular attention to science despite its importance in war itself.

Neglect of this factor is disturbing. It profoundly affects the mental alertness which is no less important to military efficiency than in civilian life. In fact, the two are so closely interlocked that the question of army education is one that may make a most important contribution to reconstruction after the War, particularly where rehabilitation and readaptation are concerned. Mr. Anthony Eden has emphasized the importance of education and welfare as a factor in keeping the Forces 'fighting fit'. The only real fitness is fitness of the whole man. A civilized nation in arms is a nation which continues to cultivate all its capacities of heart and mind, body and soul.

We may well regret that the Government was so long in making its decisions and that greater advantage was not taken of the months when relatively little actual lecturing and teaching could be done to develop the organization of the educational staff within the Forces themselves. There is still time to prevent the waste of another winter now the civilian bodies are thoroughly organized through the regional committees to meet whatever demand the Forces may make, and it is to be hoped that scientific workers themselves will not neglect whatever opportunities may be theirs in this way of spreading the scientific outlook and approach to problems of modern life.

It is equally to be regretted that in the fresh plans being formulated for the training of youth, there has been undue delay, and also there is no sign that the important safeguard which science can offer in this way against some of the most insidious dangers to democracy is yet realized. Mr. Ramsbotham's speech on October 16 went far to reassure the misgivings which had been engendered in some quarters by the proposals for the physical training of youth. There is no reason to fear that such training will be given an ex-military bias or emphasized at the expense of other sides of education, or that the day continuation scheme may be substituted for the raising of the school age. Mr. Chuter Ede, the Parliamentary Secretary to the Board of Education, explicitly declared that the suspended 1936 Act still represents the Government's policy.

There is no reason, therefore, to doubt that the Government's view of education is broad and

essentially sound. Mr. Bevin's vigorous and welcome language about educational reform indicates that there, at least, some of its members hold much more progressive views than some members of the House of Commons. We cannot, however, expect the commensurate Government action unless the House of Commons and public opinion behind it are really alive to the issues involved, and the onus for seeking to stimulate pressure for a more generous policy at the end of the War remains on those who are aware of its importance to the nation.

The raising of the school-leaving age to sixteen with satisfactory provision for continuation schools afterwards are only means to an end. They might prove as sterile as the youth movements of Germany and Italy, which are rightly shunned in Great Britain, if they do not receive the right educational content, wise use and inspiring leadership. The training of youth has to be approached in relation to the needs of youth, whether physical or recreational, as well as in relation to the needs of the community in which youth has to take its place. Peace-time industry no less than the needs of a nation in arms may make demands on the health of the adolescent inconsistent with juvenile welfare, and the consequent adjustments can only be made satisfactorily in the light of a real and far-sighted policy which is not obsessed with the immediate reactions or requirements.

Fundamentally, the training of youth to be successful must meet these requirements : it must produce leaders ; it must provide means by which youth can play its part in the national effort now ; and it must fit youth to take an adequate part not merely in a nation at war but also in the new world order to be established and in the building of that order. Those requirements can only be satisfied by a really long-range policy, broadly conceived, and embracing all the activities in welfare work and recreation, in industry and in military or naval life, which are shaping the youth of to-day and the leaders of to-morrow. Consideration of the content as well as of the manner of education is imperative and it essentially implies the introduction of a long-term national policy of scientific education.

Prof. J. H. Newton's recently published distinguished study of education for democracy* is of special interest in this respect because he goes far beyond the American conditions which are his immediate concern and lays bare the fundamental principles in the light of which particular conditions both in America and in Great Britain must be studied. From the outset he emphasizes two points : first, the relation of education to the society in which it occurs and the importance of education as an instrument for social control ; and second, the significance of the scientific method as an invaluable and indispensable method for the study of social and educational problems.

In regard to the first point, Prof. Newton refers to the constant pressure to which schools and teachers are now subjected by individuals and groups who seek to control education and direct it to the ends which they approve. The Tennessee statute forbidding the teaching of evolution is only one example of this tendency, but sufficient to show that freedom of teaching is in real danger even in a democratic State. Even the use of the schools for propaganda of the rational type, for social and moral reforms, is open to criticism and objection in view of the dangers attending it and the precedent it may afford for propaganda of a biased or anti-social type.

To object to such methods is not to assert that education has no concern for the shape of the society of the future or is without guidance as to the nature of the changes that must be effected. Education should prepare men to cope intelligently and effectively with the problems of their time. It is aimless and purposeless unless concerned both with the process of effecting changes and with the purposes to be achieved. The future citizen must learn not only how to think for himself but also how to act for himself, and teaching in which a teacher discusses practical problems without in the end indicating ways of approach is ineffective and incomplete.

All this, however, does not involve the teaching of a detailed blue-print for the new social order. Education is a social process that has social consequences, and it must at least aim at the building of minds sensitive to the social realities of the world in which they live, that are free, that have acquired the capacity of thinking for themselves, because they have had opportunity to think for themselves. This, however, in Prof. Newton's view, is insufficient. Education is also experience. It cannot be indifferent to the conditions in the social order that threaten freedom of thought, of speech and of Press and other democratic values.

* Education for Democracy in Our Time. By Prof. Jesse H. Newton. (McGraw-Hill Series in Education.) Pp. xv+242. (New York and London : McGraw-Hill Book Co., Inc., 1940.) 16*s.* 6*d.*

Education must be deliberately planned for the achievement of purposes deemed desirable. In a democracy it must at least seek to foster loyalty to the ideals of freedom of inquiry, of thought, of speech, and of publication.

Prof. Newton points out that the process of education is not merely one of acquiring knowledge in the traditional sense. Knowledge is of fundamental importance, but the way in which knowledge is acquired and the aptitudes built up in the process are also vitally important. Youth must gain some understanding of the reliance of democracy on the methods of intelligence, on the most exact methods of assembling and verifying data for utilization in the formulation of policy, and practice in the application of these methods and techniques to critical social problems of concern to them. Effective understanding by youth of the intellectual bases of democracy and of the crisis in thought arising from the conflict between the two great systems of values in the contemporary world is essential if education is to serve democracy.

It is at this point that the scientific method and the outlook involved therein fulfil a further function. Besides promoting the understanding of the great social trends and problems of our time, they afford the only adequate safeguard against the dangers of propaganda. Some knowledge of the scientific method, the ability to assemble pertinent data, to scrutinize it carefully, to make the inferences and only the inferences that the data warrant, the ability to see relations, to look beneath the surface of things are imperative assets if individuals are to resist propaganda. Revolution in the content and methods of education might well be justified if it did no more than make youth aware of the propaganda beating upon it and gave youth the ability to detect it.

The handling of the whole range of problems associated with the training and welfare of youth on such lines and in this spirit would make a vital contribution at least to the building of the peace if not also to the winning of the War. On youth itself must fall a large share of the responsibility for bringing back to sanity and balance the youth of Germany, whose education for a decade has been distorted and perverted to barbarism. Only a youth whose feet have been guided to this point can be expected to throw up and loyally follow leaders of the wide vision and moral courage required to repair not merely the ravages of war, but also to reinvigorate our democratic system, give new inspiration and meaning to its ideals and work out more effective means of serving humanity.

Prof. Newton has given us a timely book though he barely touches on one live issue to-day raised in Mr. T. C. Worsley's somewhat uneven study of the public schools and implicit in Mr. Bevin's recent remarks regarding the admission of boys of the secondary schools to the diplomatic service. The undoubted value of the public school system in providing leaders should not blind us to the basic fact that the best ability for the service of the country, whether in diplomacy or in any other field, can only be secured by recruiting it from the widest possible area of selection. A system which divides the rising generation into two sections in accordance with the incomes of their parents is not only inimical to such selection but, no less important, creates a grave obstacle to effective co-operation in adult life between those who have been systematically segregated in youth.

Prof. Newton's chapter on equality of opportunity does indeed bear on this point, although he is considering the problem as it is presented in the United States. The social waste, however, to which he refers is to be found wherever lack of resources limits the educational opportunity. It is also a function of the economic and cultural level of the country in which the children live, and the reminder that schools controlled by a particular group in society, whether political or religious, or by a social class, will be bent to the purposes of that group or class is as pertinent to conditions in Great Britain as in America. The integration of the public schools into the educational system so as to eliminate the segregating influence of financial resources, whether by pursuing the idea of the Junior Local University propounded by Mr. Worsley, or in accordance with Dr. Middleton Murry's suggestions, is one of the most important contributions which could be made to the planning of education and the rebuilding of the social order. In education the broad view and the long-range purpose are all-important. It is indeed to be hoped that the attention now being concentrated on the training and welfare of youth may not be dissipated in mere palliatives or patchwork schemes designed to meet passing needs or difficulties, but rather issue in some comprehensive policy, boldly conceived and resolutely pursued, which shall bring new strength and vigour to our democratic institutions and win acceptance and respect for those ideals in the lands where the light of liberty is for the moment extinguished.

CONTACTS AND CULTURES

THE proposal to found in London a mosque and Islamic cultural centre (see p. 712) will be a cause of gratification not only to those whose more immediate needs will be served by such an institution, but also to all who will welcome the enlarged opportunities it will afford of contacts between East and West, and of the fuller understanding which, if it does not remove, will at least lower the barriers between peoples of different cultures, beliefs, and traditional outlook. The project has taken form largely owing to the personal interest and effort of His Excellency Hassan Nashaat Pasha, the Egyptian Ambassador in London, and from the beginning it has received the patronage of King Farouk. The extent of the support it will receive in the Moslem world may be gauged from the composition of the influential committee preparing the scheme. It includes representatives of the Moslems of Arabia, of Iraq and of India in addition to those of Egypt.

The good will towards the Moslem community displayed by the British Government in its response to the appeal carries on the tradition of tolerance amid a diversity of creeds and cultural traditions, which for long has been among the more notable characteristics of British imperial rule, and now has been passed on to the British Commonwealth of Nations. It comes at an appropriate moment. The minds of men, even amid the intense pre-occupations of a bitter struggle for existence, are already casting about for solutions of the grave problems of a post-War world. Then, if all goes well, the "New Order" of democracy (to adopt Mr. Roosevelt's phrase) will be confronted with the task of recasting the conditions of life of the whole world. Not again, if we are to profit from past mistakes, will the determination of racial, or national boundaries completely fill the foreground and middle distance of the picture. It is permissible to predict that where they appear, if appear they must, it will be in the true perspective of their subordination to the general interests of the whole and not solely of the component parts. World order will, in fact, have to be adapted to conditions, some of which will have suffered a profound change, while others will have to be remoulded drastically and to a new purpose to avoid the pitfalls of the past.

Already the President of the United States invites the Americas to a co-operation based upon a spiritual unity. In Africa, General Smuts foreshadows a Union of African States. Such a union should afford an ever-increasing opportunity for those ameliorations of the conditions of human life and progress on that continent on a scale, not indeed undreamed of, but hitherto beyond the resources of individual administrative units. In Europe the agreement between Poland and Czechoslovakia opens the way to a post-War nucleus of stability in Central Europe, such as might have been formed in Western Europe had not the proposed co-operation between France and Great Britain proved abortive. Even more suggestive, because of the implications of close personal and cultural contacts, are Mr. Bevin's plans for the forging of a new industrial link between East and West by bringing some hundreds of men from the workshops of India to receive a training in the workshops of Great Britain. Thenceforward not only will India be in a position to make great strides towards fuller development of her potentialities in contribution to the world's output, at the same time raising her own standard of life, but also closer contact between individuals of both peoples will have brought fuller understanding of the problems of each.

Except in so far as such proposals can be given immediate practical effect, it is too early to attempt to evaluate them. They will have to stand the test of discussion and experience; but if the past history of the British Empire affords any criterion, their prospect of securing stability and co-operation will depend upon the degree to which they are framed to allow free play to individual cultural and traditional differences. Just as the proposed mosque in London, with all the intellectual and cultural activities of Islamic tradition associated with it, will take its place in contributing to the life and functions of the capital city of the British Commonwealth, so racial and national traditions will not, or should not, vanish in post-War adjustment, but should be preserved, so that each may make its appropriate contribution in the advancement of the general good of mankind—a general good which is not "the greatest good of the greatest number" with concessions to minorities, racial or other, but a good which admits of liberty for the individual to attain full stature, intellectual, moral and social.

THE SYMMETRIC GROUP IN MATHEMATICS

The Theory of Group Characters and Matric Representations of Groups

By Dudley E. Littlewood. Pp. viii+292. (Oxford : Clarendon Press ; London : Oxford University Press, 1940.) 20*s*. net.

REPRESENTATION theory is a subject of many aspects, having important contacts with several branches of mathematics and mathematical physics. Even if text-books were much commoner than they are, there would still be room for an introduction to the subject so admirable as this. The very diversity of the theory demands a specialized outlook from those who write concerning it, but within the limits that implies, the account given by Prof. Littlewood is excellent.

From the point of view here taken, the core of the theory is Frobenius's formula for the characters of the symmetric group. The general theory for a finite group is first developed as far as the proof of the orthogonal relations, and there follows a detailed discussion of the symmetric group. Schur functions are also discussed in detail, partly for their own sake, and partly for their applications to the representation theory of continuous groups. This is dealt with in the last two chapters of the book. In the first of these the algebraic representations of the full linear group are found directly ; in the second, the orthogonal relations for groups with closed manifolds are proved, and the characters of the unitary group and of the orthogonal and rotation groups are determined. There are also an account of spin representations, and a brief indication of the necessary modifications for groups leaving invariant an indefinite quadratic form.

The methods employed are chiefly those of Frobenius and Schur. Some use is made of the theory of linear algebras, but the problem of a synthesis of these points of view remains unsolved. The exposition is clear and concise ; but occasionally a more explicit statement of what is being done might have helped. Thus, the work on pp. 51–52 amounts to a proof that any representation of a complete matric algebra is equivalent to a direct sum of identical representations, but this is nowhere stated.

The weakest chapter is an introductory one on linear algebras, which contains errors of fact. In particular, the assertion that the regular representation of an algebra is a simple isomorphism is made without the necessary proviso that the algebra possess a modulus. It is questionable whether the modern habit of including in advanced text-books chapters designed to make them self-contained is of real value. Certainly, a student who tackled the theory of characters without more knowledge of groups and matrices than can be given in such a chapter would be most unwise.

In a book dealing with a theory so largely formal as this, some errors inevitably escape the proof-reader's eye, but the number here is surprisingly small. Altogether, the book is a very welcome addition to the series of Oxford mathematical text-books.

GRAHAM HIGMAN.

GEOLOGICAL BACKGROUND OF ENGINEERING

Geology and Engineering

By Prof. Robert F. Legget. Pp. xviii+650. (New York and London : McGraw-Hill Book Co., Inc., 1939.) 22*s*. 6*d*. net.

"TRUE engineering is the attainment of the economic solution to the problems faced, and . . . the civil engineer seeks the co-operation of the geologist so that the best advantage can be taken of the rocks to be encountered. . . ." This quotation, which in the text refers to a particular branch of engineering construction, illustrates the author's point of view throughout his book. In order to demonstrate the value of geological and engineering co-operation, Prof. Legget has brought together for the civil engineer and the engineering student a large amount of well-illustrated descriptive material relating to engineering works, from many sources—American, British and Continental. It is one of the most valuable aspects of the book that the assembling of this data in one volume renders easily accessible a body of related facts which, in a border-line subject where science and art overlap and where no two works of construction are exactly alike, must otherwise be sought through an extensive literature.

The book is divided into two parts : an introduction to geology, and geology applied to civil engineering. The first occupies less than a tenth of the whole work and is scarcely sufficient to do justice to the subject ; it seems to assume either some knowledge of geology on the part of the

reader, in view of the subsequent use of geological terminology, or a willingness to undertake further extensive reading. It is questionable, therefore, whether this short introduction really serves a useful purpose.

The second and major part of the book (which would be complete without the first) is subdivided according to different branches of the civil engineer's work; it is written in a readable style, against a background of practical experience. Beginning with a discussion of the general aspects of geology in relation to civil engineering, from the training of the student to the preparation of contract plans, the author rightly points out that "there is no special brand of geology applicable to civil engineering", but that a knowledge of fundamental geological principles should be an essential part of the civil engineer's training. Another chapter is devoted to a discussion of exploratory geological work at engineering sites, and deals, *inter alia*, with the question of costs, a matter not often referred to in a work of this kind.

Later sections cover a wide range of topics, including open excavation, landslides, tunnels, bridge foundations, reservoirs and dam foundations, ground water and water supply, building foundations, and materials of construction. Modern methods of applied geophysics are described, with notes on their uses and limitations in connexion with engineering works. The last chapter is headed "Soil and Soil Mechanics", but after a definition of the term 'soil' and a brief statement of methods of soil sampling and testing, there follows a lengthy discussion of rock weathering and glacial deposits, purely geological subjects which would properly belong to Part I; a fuller treatment of soil mechanics itself would be welcome. The modern outlook on clays and clay minerals is also summarized here.

The book concludes with a glossary, appendixes dealing with the geological surveys of English-speaking countries, geological societies and periodicals, and a valuable list of more than three hundred references to literature.

F. G. H. B.

WATER PLANTS

A Manual of Aquatic Plants

By Prof. Norman C. Fassett. Pp. vii + 382. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 26*s*.

NOTWITHSTANDING the relative uniformity of their environment, aquatic plants exhibit a remarkable variety of form and constitute a very distinct biological group comprising a considerable number of quite unrelated families. An extensive literature already exists relating to the special features of their morphology and ecology; but apart from monographs on certain genera, the group as a whole has not been analysed systematically with the view of simplifying identification. For various reasons the recognition of aquatic species is not always easy and the present work by Prof. Fassett is intended to make as simple as possible the identification of aquatic plants in sterile as well as in flowering or fruiting conditions. The species included in the Manual are those occurring in the region from Minnesota to Missouri and eastward to the Gulf of St. Lawrence and Virginia. Though the area is thus restricted, many plants are dealt with which are familiar to botanists outside America.

The book is planned so as to provide a series of diagnostic keys by which the student of aquatic biology should be able to identify such plants as he will be likely to find. The text is profusely illustrated by a large number of drawings, the author informing us that "the text is essentially a set of directions for looking at the pictures". The number of illustrations cannot be stated with any exactness since they are not numbered consecutively, but, somewhat inconveniently, in groups varying according to the size of the family. The keys to the Cyperaceæ, for example, are accompanied by 210 figures. Some idea, however, of the wealth of illustration may be gained from the fact that more than half the number of pages are devoted to drawings. They constitute, indeed, a noteworthy feature of the book, and the habit drawings and those showing details of flower and fruit structure are all equally clear and nicely done.

The text of the volume is divided into two parts, Part 1 (pp. 3–35) being a general key for the identification of the family or genus though occasionally it may lead to the actual species. Detailed treatment is given in Part 2 (pp. 36–341), a few pages being devoted to cryptogams before the phanerogams are taken. Vegetative characters are largely used in the construction of the keys, and this has the advantage of directing attention to the features of the whole plant rather than to floral characters alone. The number of species, together with varieties and forms, is surprisingly large in a book which bears the title it does, and Prof.

Fassett has evidently experienced difficulty in deciding where to draw the line between aquatic and terrestrial. For his present purposes he defines an aquatic "as a plant that may, under normal conditions, germinate and grow with at least its base in water and is large enough to be seen with the naked eye", a definition which must inevitably raise difficulties regarding the selection of species. The author admits that the list is highly subjective and that no two botanists would be likely to draw up the same list of species. Many of those included are plants of swamps or wet situations by the margins of lakes or rivers. The bog habitat is said to be excluded, though not a few plants find admission which do, in fact, occur in bogs.

An appendix gives a brief but useful statement regarding the use of aquatic plants by birds and mammals, and the volume concludes with a glossary and index. J. R. Matthews.

AMERICAN APPLIED SYLVICULTURE

Applied Sylviculture in the United States
By Prof. R. H. Westveld. Pp. vii + 567. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 25*s*. net.

THIS book may be regarded as one of the most informative works on some important branches of forestry which has appeared. Carefully prepared for the United States and profusely illustrated, Prof. Westveld's work will well repay a study far outside that country. This is not a treatise on sylviculture pure and simple; the word 'applied' in the title is doubtless intended to correct such a diagnosis.

The author divides his book into eighteen chapters, as follows: i. North-east spruce—hardwood region. ii. New England white pine region. iii. Oak region. iv. Allegheny hardwood—pine—hemlock region. v. Southern Appalachian region. vi. Southern Pine region. vii. Southern Bottomland hardwood region. viii. Central hardwood region. ix. Lake States region. x. Douglas Fir region. xi. Northern Rocky Mountain region. xii. Lodgepoke pine region. xiii. Southwest Ponderosa pine region. xiv. California pine region. xv. Northwest Ponderosa pine region. xvi. Black Hills Ponderosa pine region. xvii. Redwood region. xviii. South-eastern Alaska. The method of treatment of each of these chapters is on similar lines, as follows: *Description:* Location and land ownership, physiographic features, climatic features, development of lumbering, effect of past practices. *The Forests and their Management:* composition and character, stand regeneration and development, windfall, utilization and marketing problems, growth and rotation, financial aspects, application of sylvicultural methods, slash disposal and effects, disease and insect problems, control of animal and logging damage.

Some of the above heads and investigations go beyond the definition of sylviculture as understood in Europe, or, we may add, India, where a correct forestry practice has been in force for nearly eighty years. It might be suggested that even 'applied' sylviculture should not include such distinctive branches of forestry as protection and utilization.

The varied nature of the forestry problems the United States have to face is evidenced by the total areas shown in each of the above chapters as occupied by forests, either national forests, forests owned by the individual States, and those in private ownership—from the great lumbering organizations and other forest-owning private bodies and individuals down to the small farm-lot woodlands.

A very rough analysis of areas gives the following interesting figures. Total area of forests and forest lands (the latter of a varying type in degrade) is approximately 601 million acres. The national forests occupy approximately 150 million acres; the forests of the several States approximately 19 million acres, whilst 432 million acres are occupied by the various categories designated as private forests.

The most informative and fascinating parts of the book are the author's treatment of the sylvicultural problems confronting United States foresters. The forester in India is well aware that, owing to the diversity in climate, typography, and so forth, sylvicultural methods and operations will require different treatment in accordance with the varying conditions and species, etc. The same is true in the United States, with the proviso that conifers (instead of broad-leaved species as in India) cover the preponderating area of the forests, and that lumbering, disastrous fires, and large areas of second-growth forest of very varying uniformity in growth introduce an added complexity to sylvicultural values and their study and treatment. Prof. Westveld has dealt with these problems in a most instructive fashion.

E. P. Stebbing.

FOOD PRODUCTION IN GREAT BRITAIN AND IN WESTERN EUROPE

By Sir John Russell, F.R.S.,
Rothamsted Experimental Station

INFORMATION about food production in Great Britain is readily obtainable from the excellent volumes of statistics issued by the Ministry of Agriculture and the corresponding body in Scotland. Hitherto it has been difficult to compare these results with those obtained in Western Europe; the data of course existed, but they were scattered through many volumes in a variety of languages, and as they were not necessarily comparable there were many pitfalls for the unwary student. Agricultural statistics are particularly troublesome things to handle. The difficulty is largely met by a recently published book by Mr. P. Lamartine Yates, which comes at a most opportune time*. The material was assembled and checked on an agricultural journey in 1938, and both the author, and Lord Astor and Mr. Seebohm Rowntree, who were the prime movers in the enterprise, are to be congratulated on its accomplishment.

Mr. Yates deals exhaustively with the Western European countries, France, Belgium, Holland, Denmark, Sweden and Germany, and in his final chapter makes the comparisons with Great Britain. The section on France is particularly interesting, written with understanding, even affection, but faithfully. He recognizes the Frenchman's intense individuality and his dual loyalty to his *pays* or province, and to his *patrie*, France; while these qualities have played their part in the recent *débâcle* they would put serious difficulties in the way of reorganization on German lines with the French as a *race asservie*. One thinks of France as being more agricultural than England and Wales and so far as population is concerned this is true, but not in regard to the use of the land; more land in Great Britain is devoted to agriculture than in France or Germany. The figures are given in Table 1.

In northern France the chief crops in order of importance are wheat, oats, lucerne, the root crops, potatoes, mangolds, sugar beet, usually grown in a three- or six-course rotation; wheat, oats, lucerne; wheat, oats, roots; less than a quarter of the land is in permanent grass. In the south cereals occupy only about 25 per cent of the arable land, as against 60 per cent in the north, and many special crops are grown: vines, fruit, vegetables, tobacco and maize; some 60 per cent of the land is in permanent grass by reason of its elevation. As in other countries the arable land tends to go down to permanent grass.

Table 1.
Land utilization per cent of total area.

	England and Wales	France	Germany
Agriculture	67	60	61
Forest	6	20	27
Waste and rough grazing*	14	10	4
Non-agricultural uses	13	7	8

* Waste in France and Germany; rough grazing in England and Wales.

France produces about 90 per cent of its wheat requirements, against about 15 per cent in Great Britain; but the yields are lower than in the latter. Potatoes are widely grown far exceeding human requirements, and quantities are fed to pigs; sugar beet is much more localized. As in Great Britain, sheep fell greatly in number after high levels between 1876 and 1896; but the rise which began about 1920 has not gone so far as in Great Britain. Cattle, on the other hand, increased almost continuously in number, and before the War were higher than ever before. Pigs had fallen greatly in number during the War of 1914–18, but rose steadily and before the War were almost at the best of the earlier levels. About 50 per cent of the farmed land is held in 25–125-acre holdings; about 20 per cent in holdings of less than 25 acres and 30 per cent of more than 125 acres. Large farmers are found mainly in the arable regions of the north.

German agriculture is, of course, very different. An east-west line drawn through Cologne, Dresden and Breslau divides Germany into two parts; to the north is the low-lying, almost featureless sandy plain that travellers to Berlin and Warsaw often found rather tedious; to the south are mountains, uplands and forest. The soil of the northern plain is rather poor. In the eastern part the farms are large; 1,000 acres is a usual size, but 10,000 acres is not uncommon. Only some 10–20 per cent of the land is in grass by reason of the low rainfall; rye and potatoes are the chief crops; the potatoes are both for human consumption and for industrial

* Food Production in Western Europe: an Economic Survey of Agriculture in Six Countries. By P. Lamartine Yates. Being the Report of an Inquiry organized by Viscount Astor and B. Seebohm Rowntree. Pp. xv+572+16 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 15s. net.

use, and most of the large farmers have their own distillery or starch factory. In north-west Germany farms are small, 50–300 acres, but prosperous ; dairying is the chief industry, based on grassland near the coast, and on arable crops farther inland in Westphalia. The south-west is mainly in small holdings ; it is a rich country producing fruit and vines, poultry, pigs and milk. Central Germany, the Anhalt region, including Magdeburg and Halle, has larger farms and much sugar beet, while Bavaria produces much milk on its arable plateau and grassy uplands. The utilization of the land is almost the same as in France, excepting that forest occupies 27 per cent and waste only 4 per cent.

Sixty per cent of the arable land in Germany was (1937) in corn, 22 per cent in roots and 11 per cent in temporary grass ; for Great Britain the figures are 50, 25 and 25 per cent respectively (fodder crops and fallows are included with the roots) ; a typical rotation is roots, corn, corn, which may be followed by grass, corn, corn ; for example, on the northern plain one often finds potatoes, rye, oats, but rye is the commonest grain crop occupying 10¼ out of the 28 million acres of grain ; it is much better suited to the sandy soil than wheat. As in other countries, there is a tendency to lay down arable land to grass. Since 1914 the percentage of the farmed land used for arable crops has fallen from 75 to 68. Yields of grain are approximately the same as in Great Britain—wheat is a little less, so are potatoes, but yields of sugar beet and hay are higher. Much more labour and fertilizers are expended per acre than in Great Britain, but there is less manuring through the animals than here. Up to 1930 some 25–30 per cent of the animal food was imported as in Great Britain, but since the Nazis came into power great efforts have been made to dispense with importations and substitute home-grown food ; considerable success has been achieved. Numbers of livestock are less then they were before the War of 1914–18, sheep indeed having decreased drastically. Pigs are the chief meat producers, furnishing about two thirds of the nation's meat requirements ; there are 25 million of them compared with less than 4 million in Great Britain.

The rural population has for years past been falling, but since the advent of the Nazis the fall has greatly increased. At first farm workers were forbidden to leave the land ; but in 1936, when industry was short of labour, this prohibition was withdrawn, and during the next three years nearly a million workers went. Then, however, the decree was reimposed and indeed strengthened ; the workers in 1939 were practically tied to their occupations. Concurrently efforts were made to reduce the need for labour by increasing the amount of machinery available. There was always a seasonal labour deficit and this was made up by importing farm workers from Poland, Czechoslovakia, Yugoslavia and Italy ; the Nazis disliked it because they considered the farm should be a "Germanic entity", free from alien elements. It would be interesting to know how the farms stand now in this respect. In order to ensure a continuance of peasant farming the Farm Inheritance Act of 1933 provided that farms of peasant size could not be sold or subdivided, nor could the owner borrow money on the security of the land ; he is in effect tied to his land as it is tied to him. Peasant owners must be racially pure, politically reliable and technically efficient. The heir need not be the eldest son ; often indeed he is the youngest.

The agriculture of the smaller and until recently, freer and more productive countries, Denmark, Holland, Belgium and Switzerland is described in "Food Production in Western Europe" in detail, and as one reads the accounts one realizes the depth of the tragedy that has overwhelmed them. All these countries had attained high levels of technical skill and output, but the systematic

TABLE 2.
FOOD CONSUMPTION IN LB. PER HEAD PER ANNUM. (P. LAMARTINE YATES).
(1934–38)

	Great Britain	Denmark	Netherlands	Belgium	France	Switzerland	Germany
Bread and flour*	197	198	200	250	280	200	222
Potatoes	210	264	—	440	400	198	398
Sugar	109	120	58	62	56	97	56
Beef and veal	66	53	39	40	46	55	34
Pork	48	72	50	45	20	48	65
All meat	143	125	91	90	74	108	100
Milk (gall.)	20	36	26	20	23	58	21
Butter	22	17·2	14·5	20·6	13·3	14·3	16·4
Margarine	8	45	15	10	—	—	15·5
Cheese	9·5	12·1	14	6·4	12·5	18·5	12·6
Eggs (No.)	153	90	100	236	149	156	126

* In terms of flour.

Table 3.
Agricultural output 1937. (P. Lamartine Yates).

	Output per worker, £		Wages per hired worker, shillings	Acres per worker	Stock units per worker	Output per acre*, £	
	Gross	Net				Gross	Net
Great Britain	240	200	30–36	33·8	10·3	7	6
Denmark	180	155	23–26	15·7	8·4	11	10
Netherlands	150	120	23–30	9·0	4·9	17	14
Belgium	110	100	18–22	7·4	3·4	15	14
Switzerland	110	100	27–29	7·1	4·3	17	15
France	90	90	20–28	11·6	2·8	8	8
Germany	70	70	18–23	7·9	2·8	8	8

* Rough grazings in Great Britain reckoned at half their average, and Alpine grazings in Switzerland at one quarter.

plundering to which Denmark, Holland and Belgium are now being subjected will gravely impoverish them for years. They were far ahead of Germany in output per man and in output per acre. Unfortunately, their prosperity aroused Nazi covetousness and proved their undoing. In pre-War days they had sent Great Britain quantities of food, notably butter, eggs, bacon, early vegetables and certain fruits. In war-time these supplies are all cut off, and so far as they still exist are deflected to Germany. But much of the intensiveness of their agriculture was due to the importation of large quantities of feeding stuffs and fertilizers, most of which are no longer obtainable ; their output will therefore be considerably lowered.

British farmers have a much more difficult task than confronts the Continental and particularly the German farmer. The peace-time dietaries of the Western European countries are stated by Mr. Yates as in Table 2.

The English dietary included considerably more meat (especially beef and mutton), sugar, butter, fruit and vegetables than the German, but only half the potatoes and 12 per cent less bread. On average British yields, 1·6 acres are necessary to produce the food of the British consumer unit ; the limited land area can at this rate feed only 40 per cent of the British people. The German dietary, on the other hand, requires little more than half this land per head, and as Germany has twice the area of agricultural land that Great Britain has, but less than double the population of the latter, it is not surprising that they can attain more than 90 per cent of self-sufficiency against 40 per cent in Great Britain. Indeed the more one studies the two systems the more one realizes how superior the German is for war-time. Moreover, the details have been well worked out. Thus in spite of the fact that the pig is the most economic transformer of food into meat, Great Britain will have to reduce her pig population while retaining her sheep and cattle, because pigs consume food suitable for milk production or for human beings, while sheep and cattle do not. The German farmer will be able to keep many of his pigs, for a system of feeding has been worked out that requires much less concentrated food. Other technical difficulties had also been met ; indeed so long as the Germans can draw forced labour and agricultural produce from surrounding countries they cannot be starved out, although they can be made uncomfortable.

The British farmers' activities have been in quite a different direction. In the years that followed the War of 1914–18, when but little interest was taken in agriculture, the farmer's task was to survive and to meet the rising costs of wages resulting from the competition of industries moving southwards. He solved the problem by increasing his own efficiency and that of the workers. Mr. Yates's figures showing the relative output per worker in the different countries' areas are given in Table 3.

The net output of the British agricultural worker is three times that of the French or German ; the gross output is still higher. No other European country begins to equal Britain in this respect. But this high output per man has not given us high output per acre. In some ways the two things are opposed, and countries of high output per man frequently have low output per acre. The relation, however, is not rigid, and it is possible to achieve high output per acre and high output per man ; that is the problem now confronting British agriculturists. There is no evidence that it can be done simply by enlarging our farming units ; the countries that far surpass us in output per acre are all lands of small holders. But there is also no evidence that the setting up of small holdings would give any better result ; in spite of considerable public expenditure on small holdings the numbers have continuously shrunk. The reorganization must be in the direction of making fuller use of the technical and scientific knowledge now or in future available so as to increase the efficiency of the land as well as that of the worker. The crux of the problem lies in the uncertainty of prices of agricultural produce. Farmers have to start

spending money on crops and stock many months before the produce can be sold, and in the meantime prices may have fallen considerably. Farmers cannot take indefinite financial risks and must play for safety. No other producers of commodities are in so insecure a position; all, except farmers, are always protected by contracts.

A similar arrangement seems indicated for agriculture. The total food requirements of the nation are fairly accurately known; it should not be difficult to allocate them to the various supplying countries and so to settle what should be the share of the British farmer. Contracts could then be made; the farmer to supply specified quantities, and the buying agency to pay specified prices which should move, however, with wages, since these are fixed by statutory bodies. Arrangements of this kind have for some time been in force for milk, sugar beet and wheat, and have led to the adoption of improved methods and increased output. The same principle is being tried for meat, a much more important farm product. Of course, it means a certain amount of planning, but this seems inevitable in our national life after the War. Our fundamental problem will be to reconcile planning with the liberty which none of us would be prepared to give up, but this certainly should not prove insoluble.

ANCIENT MESOPOTAMIA AND THE BEGINNINGS OF SCIENCE*

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THE thesis which it is proposed to outline here embodies the following propositions: (1) Available evidence points to Mesopotamia as the oldest known centre of scientific observation permanently recorded. (2) Whatever its immediate objectives, this activity comes to include such widely separated fields as education and language study, jurisprudence, and the mathematical and natural sciences. (3) The numerous elements in this broad advance are interrelated basically. The common underlying factor to which the initial impetus can be traced is a concept of society whereby the powers of the State are restricted and the rights of the individual receive a corresponding emphasis. (4) It is significant that under the opposite social system of totalitarian Egypt early scientific development differed in scope as well as in degree; while notable in certain special fields, such as medicine and engineering, it lacks the breadth and balance manifested in contemporary Mesopotamia.

There were certain features in protohistoric Mesopotamia which tended to encourage scientific progress. The results happen to constitute the first recorded evidence of scientific performance known to us to-day. To this extent we are justified in touching here upon the beginnings of science, including the natural sciences. But it should be made clear at the outset I am concerned not so much with the results as with the background; a combination of circumstances conducive to concerted activity rather than the subjects affected by that activity. The background gives us in this instance the essential starting point; it is thus more significant than the immediate achievement.

Our interest, then, centres on a particular cultural stage at which there were at work forces that led to extensive scientific developments; forces which provided the predisposition, so to speak, to these developments. Accordingly, we shall ignore such sporadic achievements of a still more remote age as the invention of the wheel, the introduction of the brick-mould, and perhaps the use of instruments in effecting accurate geometric designs on very early forms of painted pottery. We may have here Mesopotamian inventions which were to play important parts in the eventful progress of engineering, architecture, and perhaps geometry; but these inventions represent isolated contributions of discontinuous cultures which scarcely had any immediate bearing on scientific progress.

The region to which our inquiry will take us is Lower Mesopotamia, the land of ancient Sumer. More specifically, it is an area extending southwest from the environs of Babylon, past Uruk—the biblical Erech—and on along the Euphrates to the metropolis of Ur. The time is the middle of the fourth millennium B.C. This is not just a convenient round figure. It will allow a margin of scarcely more than a century, and in a total of more than five thousand years this is not a disproportionate margin of error. We are in a position to establish the time with such accuracy because

* Substance of a paper read at the Bicentennial Conference, University of Pennsylvania, on September 16.

it falls within a well-stratified cultural period marked off sharply by distinctive material remains. Soon after there begin to appear inscribed records which link up before long with concrete regnal years and provide thus a basis for absolute chronology.

We get our first inscribed documents from a level dated to shortly after 3500 B.C., one of a long series of strata recovered from the remains of ancient Uruk. It is among these documents, written on clay, that we find a few which represent the earliest known scientific records. That similar records of still greater antiquity will ever turn up outside Mesopotamia is highly improbable. All available evidence points to the conclusion that the scientific notations with which we are concerned were compiled in close association with the introduction of writing itself. To be sure, this evidence applies only to the script of Mesopotamia. But writing in all the other ancient centres of civilization is demonstrably later. In Egypt it was introduced some centuries after it had been evolved in Mesopotamia, and its first appearance in India was later still. As for the script of China, there is nothing to indicate that it was earlier than the second millennium B.C. It follows, therefore, that the scientific notations on our earliest Mesopotamian tablets constitute not only the first evidence of scientific activity in Sumer, but represent also the oldest recorded effort of this kind known from anywhere in the world.

What is it that would justify the use of the term 'scientific' as applied to a few of the oldest inscribed documents from Mesopotamia? The answer is bound up with the character and purpose of these special texts. Each of them contains lists of related entries. But these lists have nothing in common with the customary inventories of a strictly economic nature. They serve an intellectual rather than a material purpose; and yet, they are to enjoy a continuity and distribution which will set them off sharply from the usual run of business documents the significance of which is at once temporary and local. The lists in question are destined to be copied and recopied for many centuries and in more than one city and country. Actual examples of such copies, often modified and expanded, but still in a clear line of descent from the oldest prototypes, have been discovered in Mesopotamian sites of much later age, and even in foreign capitals like Elamite Susa. We have thus before us the beginning of a family of documents of a scholarly character which are notable for their continuity, distribution, and purposeful adherence to an established tradition[1].

In this recording of accumulating experience and the manifest applicability of such records to the needs of cultural centres separated by political, linguistic, and chronological barriers we have the essential ingredients of scientific performance. Now what science or sciences did this activity embrace? We shall see presently that the primary purpose of the lists under discussion was to aid in the preservation of the knowledge of writing. Before long, philological studies become an added objective, owing largely to the composite ethnic and linguistic background of early historic Mesopotamia.

Natural sciences, too, soon get attention. For regardless of the primary purpose of these lists, they happen to include quite early in their history groupings of birds, fish, domestic animals, plants, and the like. It is worth stressing that these compilations presuppose careful observation and imply organization and analysis of the accumulated data[2]. As an element in the cumulative tradition of the land the lists are subject to steady expansion and improvement. What is more, although these texts were calculated originally to serve purposes unrelated to their subject-matter, they lead in course of time to the independent study of the subject matter involved. The fields affected are zoology and botany, and later on geology and chemistry. The first recognition of all these subjects as so many separate fields of study may be traced back, therefore, to the earliest inscribed documents from Mesopotamia.

The subsequent progress of the individual sciences just mentioned has to be traced by specialists. We are concerned at present with the initial impetus alone, and the time and circumstances in which that impetus was first received. A few details, however, may be brought out in passing. In the light of the foregoing remarks botanists will not be surprised to learn that many of the terms which they use to-day are found in Mesopotamian sources. These terms include cassia (cuneiform *kasû*), chicory (*kukru*), cumin (*kamûnu*), crocus (*kurkânû*), hyssop (*zûpu*), myrrh (*murru*) nard (*lardu*), saffron (*azupirânîtu*), and probably many others. The zoological compilations which are accessible in cuneiform records contain hundreds of names systematically arranged and presented in two columns, the first giving the Sumerian term and the other its Akkadian equivalent[3]. The scholastic tradition in chemistry results in such texts as the one which has come down to us from the second millennium B.C., wherein a formula for glazing pottery is preserved in the guise of a crypotogram so as to remain hidden from the uninitiated[5]. The importance of natural science for the study of medicine is self-evident; it was not lost on Babylonian and Assyrian medicine.

So much for the indirect benefits derived from the lists under discussion. But the primary

objective of these compilations was not allowed to suffer in the meantime. On the contrary, the direct results which were achieved with their aid led to an immensely fruitful advance in another field of intellectual progress.

It was stated above that the lists were intended as a means of preserving the newly attained knowledge of script. By the very nature of its origin in concrete pictographs, early writing was an elaborate medium consisting of thousands of items. To each new prospective user it represented a code which could not be deciphered without a proper key. The lists were calculated to supply that key. They were analytical catalogues of signs arranged according to form. Inasmuch as each sign was at first a reflection of something specific in the material world, these catalogues were at the same time systematic groupings of related objects; hence their incidental value to the natural sciences, as we have just seen. The immediate purpose, however, of these arrangements was pedagogical; they are our oldest manuals for the discipline of education. As pictographs and ideograms gradually took on abstract phonetic values, the study of the script became linked perforce with the study of language. After the Semitic-speaking Akkadians had joined the Sumerians in building up the civilization of Mesopotamia, linguistic studies rose to exceptional heights against this bilingual background.

The foregoing outline shows that many forms of scientific progress in Mesopotamia were influenced and linked together by a scholarly tradition which was in turn the by-product of the invention of writing. Our survey has failed, however, thus far to include mathematics and astronomy, two fields for which Mesopotamia has long been celebrated. It need scarcely be said that these subjects were affected no less than the other disciplines by the same forces which made for a broad cultural advance in general. But the primary cause of the extraordinary development of mathematical and related studies in Mesopotamia is to be sought, I believe, in conditions which antedate the introduction of writing. In fact, I would add, the origin of writing as well as the interest in mathematics are to be traced back, in this case, to a common source. This source will be found inherent in the society and economy of the prehistoric Sumerians.

We know to-day that the Sumerians got their idea of writing from the cylinder seals which they engraved with various designs to serve as personal symbols. These symbols came to be employed as marks of identification for religious and economic purposes, for example, with temple offerings. In this representational function the old designs develop into concrete graphs for humans, animals, plants, and so forth, and thence for temples, gods, and cities. The graphs are then associated in each instance with specific words. The gap between picture and word is bridged. Gradually means are devised to express not only complete words but also component syllables, the advance leading thus from the concrete to the abstract. At length writing is perfected to function as a flexible medium for the recording of speech and thought[5].

When we look back now on the successive interlocking stages in this complicated process, which has been sketched here in its barest outlines, an interesting fact will emerge. The early Sumerians had not set out at all to invent writing. They were carried to this result by a combination of peculiar circumstances.

We have seen that the immediate ancestor of Mesopotamian writing was the cylinder seal which was first and foremost the Sumerian's mark of ownership. Impressed on clay or cloth it served to safeguard in the eyes of god and man one's title to possessions or merchandise. We have here a clear indication of a strongly developed sense of private property and thereby of individual rights and individual initiative[6]. The curious shape of the cylinder seal, original with the Sumerians, is explained by its use as a mark of individual ownership. For such cylindrical objects are well suited to cover uneven surfaces with their distinctive design[7].

Wholly consistent with this economic origin of writing is the fact that the earliest written documents are given over to temple economy. Later texts branch out into the field of private business. Both these uses testify independently to the importance attaching to property rights. Records of a non-economic character are the last to appear, except for the lists discussed above, which served as direct aids to writing. The first inscribed documents were used, accordingly, for economic ends, precisely as the cylinder seals themselves. It is easy to understand why the oldest pictographs were so often identical with the designs on the seals.

It follows that Mesopotamian writing, and hence the first script known to man, was the unforeseen outgrowth of a social order which was founded on a recognition of personal rights. This basic feature of Sumerian society is attested overwhelmingly in cuneiform law, perhaps the most characteristic and the most abundant expression of ancient Mesopotamian civilization. In the last analysis this law rests on individual rights. It is not surprising, therefore, that proof of ownership becomes a vital necessity under this system. Incidentally, the rigid requirement of such proof is the main reason for the hundreds of thousands of legal documents recovered from the buried sites of

Mesopotamia; the forces responsible for the introduction of writing continued thus as the primary factor in the subsequent popularity of script. The law applies to ruler and subjects alike. The king is at first no more than a 'great man', as is shown by the Sumerian etymology of the term as well as the form of the corresponding pictograph. He may become the administrator of a vast empire; but even then he is still the servant, not the source of the law, and is responsible to the gods for its enactment. There is here no encouragement of absolute power. Law codes are the constitution which guides the ruler and safeguards the subjects. We have seen that this system is capable of promoting cultural progress on an extensive scale. Its inherent vitality is evidenced by the ease with which this order maintains itself for thousands of years in spite of a succession of political changes under the Sumerians, Akkadians, Gutians, Babylonians, Kassites, and Assyrians. Nor is further expansion hindered by ethnic or linguistic obstacles in its path; for distant and heterogeneous outsiders are attracted not infrequently to the orbit of the Mesopotamian civilization. Among the newcomers we find the Elamites, the Hurrians, and the Hittites, the last-named a people of European ancestry and Indo-European speech. Incidentally, it is to the influence of Mesopotamia upon the Hittites that we owe to-day our oldest available records of any Indo-European language. The newcomers proceed to copy the laws, use the script, and enjoy the other benefits of the adopted civilization.

Enough has been said to imply that mathematics and time-reckoning were bound to prosper against this social and economic background. An obvious corollary is preoccupation with metrology, with the result that Mesopotamian weights and measures spread eventually beyond the domain of the parent culture[8].

To sum up, there existed an intimate relation between scientific progress in Mesopotamia and the source of historic Mesopotamian civilization. Underlying all was a social order resting on the rights of the individual, embodied in a competitive economy, and protected by the supreme authority of the law. This system brought about the evolution of writing, henceforward a decisive factor in the advance of civilization and its diffusion past the changing ethnic and political boundaries. We have here the essentials of a truly cosmopolitan civilization, notable for its assimilatory power and a science broad in scope and balanced through the inner unity of its many branches.

Would this story of scientific development have differed appreciably under another type of civilization? The answer is hinted at in one of history's most magnificent experiments. The one centre possessing a culture of comparable antiquity but dissimilar social and economic background was Egypt. Here the king was a god and as such the absolute ruler and titular owner of all that his realm contained. Under this concept of government there was no room for the recognition of private ownership of property and the all-embracing power of the law. The pharaoh was dictator of a State genuinely and thoroughly totalitarian. The pyramids bear lasting and eloquent testimony to his enormous authority.

We are not concerned here with the respective merits of two contrasting forms of government. Our interest is confined for the present to the effect of co-existent civilizations upon the progress of science in the two centres under comparison. The perspective of more than five thousand years cannot but deepen our appreciation of the debt which modern life owes to both Egypt and Mesopotamia. By the same token, however, we are able now to view objectively some of the differences between their respective achievements.

The established superiority of Mesopotamian mathematics may be attributed, in part at least, to the stimulus of the local economy, so different from the Egyptian. Opposed concepts of property ownership and the fundamental rights of the individual were responsible for the intensive pursuit of legal studies in the one instance and their subsidiary role in the other. The astounding accomplishment of Mesopotamia in the field of linguistics had no adequate counterpart in Egypt. Now we have seen that in Mesopotamia progress in linguistic studies, not to cite now other branches of science, was linked intimately with the development of writing. But was not Egyptian writing a correspondingly potent factor?

If this question cannot be answered with complete confidence it is largely because the origin of the Egyptian form of script is still open to conjecture. Some details, however, are certain and beyond dispute. The earliest inscribed records of Egypt are some centuries later than the first written documents of Mesopotamia. In Sumer we can follow the successive palæographic stages step by step, whereas in Egypt the formative period of writing seems to have been very short indeed, to judge from the available material. Moreover, writing left in Sumer a clearly marked trail which leads back to a specific social and economic set-up; in Egypt there is no such demonstrable relationship. Because of all these facts, and in view also of commercial and cultural links known to have connected Egypt and Mesopotamia at the very period under discussion, it is logical to assume that Egypt imported the idea of writing from Mesopotamia. Differences in the form and use of the signs would correspond, then, to the existing

differences in the art and languages of the two cultural centres. On present evidence, any other assumption would leave far too much to coincidence[9]. In the final analysis it is not so much a question of the mere use of script as of the conditions responsible for the original emergence of writing.

At all events, Egyptian writing, regardless of its origin, inevitably played its part in the notable progress of Egyptian science. What we miss here, however, is the scope and inner unity of scientific advance which are found to be so characteristic of Mesopotamia. That unity was the product of a tradition which is traceable ultimately to a particular concept of life. In totalitarian Egypt a different set of values attached to life and government and tradition. Is this the reason for an effort that seems more sporadic, greater perhaps in its power of concentration on specific objectives, but also more conspicuous for its omissions? Over a period of millennia this appears to be a justifiable comparative appraisal of the results achieved in the field of science by the two oldest historic civilizations.

[1] These facts are brought out clearly by A. Falkenstein, whose "Archaische Texte aus Uruk" (Berlin, 1936) is the basic work on the earliest documents from Mesopotamia; cf. especially pp. 43 ff.

[2] Careful observation is evidenced also by the accurate drawings of the early pictographs, particularly where exotic animals and specific plants were concerned.

[3] See Benno Landsberger (in co-operation with I. Krumbiegel), "Die Fauna des alten Mesopotamien" (Leipzig, 1934).

[4] On this subject see R. Campbell Thompson, "A Dictionary of Assyrian Chemistry and Geology" (Oxford, 1936).

[5] R. Campbell Thompson and C. J. Gadd, in *Iraq*, **3**, 87 ff. (1936).

[6] Cf. E. A. Speiser, "The Beginnings of Civilization in Mesopotamia," *J. Amer. Oriental Soc.*, Supp. 4, **59**, 17 ff., esp. 25–28 (1939).

[7] See H. Frankford, "Cylinder Seals" (London, 1939), p. 2.

[8] Note the article by V. Gordon Childe, on "The Oriental Background of European Science", *Mod. Quarterly*, **1**, No. 2, 105 ff. (1938).

[9] Cf. Speiser, *op. cit.*, 22, note 12, and Siegfried Schott, in Kurt Sethe's "Vom Bilde zum Buchstaben" (1939), pp. 81 ff.

BROADCASTING IN INDIA

THE task of providing an efficient radio broadcasting service in the Indian Empire is beset with many problems which are peculiar to that country and which other broadcasting organizations in Europe and America have not encountered. India is a country of relatively great distances and a vast population, most of whom have a rather low standard of living. Nearly thirty times the area of England, the population numbers more than 300 millions, speaking some 200 different languages, of which about 16 are in common use. From a technical point of view India is subject to a frequent and very high atmospheric disturbance level, and this calls for special consideration in the choice of wave-length and power of the transmitting stations, if a satisfactory programme service free from interference is to be obtained. Furthermore, it was clear many years ago that a broadcasting service could not be built up out of licence revenue as was done in Great Britain. These and other problems have occupied the attention of the Government of India over the past thirteen years, since the first broadcasting station was opened at Bombay by Lord Irwin in July 1927. In his speech on this occasion the Viceroy indicated that India offered special opportunities for the development of broadcasting, and that although it was then in its infancy, he had little doubt that, before many years had passed, the numbers of its audience would have increased very considerably and that this new application of science would have its devotees in every part of India.

The long and varied struggle which the Indian State Broadcasting Service has had since the date mentioned above is recounted in a recent publication from Delhi entitled "Report on the Progress of Broadcasting in India, up to the 31st March 1939"*. A second broadcasting station was opened at Calcutta in 1927, by the end of which year the number of licensed listeners was less than 3,600. Although this number was soon doubled, the rate of increase remained sensibly unaltered from 1929 until 1932, when the inauguration of the Empire Service of the British Broadcasting Corporation led to a sharp rise in the rate of increase to more than 16,000 listeners by the end of 1934, although there were still in operation at this time only the two broadcasting stations already mentioned. Soon after this time, the first Controller of Broadcasting of the Government of India assumed charge of the organization known as All India Radio, and set to work to develop broadcasting into a service appropriate to the needs of the country. In view of the lack of technical experts in India with any long experience in broadcast engineering, considerable assistance was obtained in this connexion from the B.B.C. in Great Britain.

The development policy, upon which work has been actively progressing during the last two or three years covered by the report, envisaged the establishment of nine medium-wave stations and five short-wave stations, one of which, situated at Delhi, was specially assigned for the transmission of news from a central point. The basis of the scheme of using medium-wave stations operating on wave-lengths between 200 and 400 metres followed the experience gained in Europe and

* Report on the Progress of Broadcasting in India up to the 31st March 1939. Pp. xiv+230+21 plates. (Delhi: Manager of Publications, 1940.) 3 rupees; 5*s*.

America, and it was considered that the nine stations projected would provide a first-grade medium-wave service at important centres of population. In order to reach the rural population, however, it is necessary to spread the service over relatively great distances and this factor, together with the prevalence of some atmospheric disturbances, led to the supplementary scheme of the provision of short-wave transmitting stations. The application of short wave-lengths to Indian broadcasting differs in one very important aspect from the application made by European countries, in so far as in India the short-waves were required for an internal broadcasting service, whereas in European countries the short-wave service is primarily intended for overseas listeners. This difference in requirements leads to the use of different wave-length bands in the two cases, and therefore fortunately to an absence of interference. The Indian short-wave stations normally operate in the day-time in the wave-length bands of 30 and 49 metres, which are used by the European international stations only at night ; while in India at night, the wave-length bands of 60 and 90 metres are utilized, and these are not used by broadcasting stations operating an international service.

At the inauguration of the above scheme, it was estimated that if the short-wave transmitters were of a power rating of 10 kilowatts they would have an intelligible, if not satisfactory, service range of about 500 miles. The four stations projected for general use could therefore be regarded as covering the whole of India, and providing a service which, if not entirely free from fading, would be not unsatisfactory to the average listener. The installation of four such stations instead of one high-power medium-wave station possessed a marked advantage in providing the possibility of alternative programmes which, owing to difficulties arising from timings, languages, Indian and European music and so forth, would clearly be very desirable. During the years 1937 and 1938 the four short-wave stations came into operation, and these, together with the new and already established medium-wave stations, resulted in twelve of the fourteen projected stations being in service use at the date of presentation of the report referred to above. The whole scheme was financed by a capital grant from the Government of some £300,000, from which a balance of about £120,000 remained on April 1, 1939. The overall annual expenditure of the All India Radio organization has risen steadily to nearly £190,000 for the year 1938–39.

In the early days, the engineering and technical control of broadcasting in India was conducted by the Posts and Telegraphs Department. Afterwards these activities were transferred to All India Radio under the Controller of Broadcasting, in order to avoid the admitted difficulties of divided control between administration and programmes and engineering. Considerable space is given in the Controller's report to the activities of the Engineering Department, which is concerned mainly with the maintenance and operation of existing broadcasting stations ; the planning and installation of new broadcasting centres ; and with development and research work of a technical nature.

Any broadcasting system must make extensive use of direct connexions between the various stations so that programmes originating at one station may be radiated from others. These connexions are usually effected by telephone lines suitably designed and installed for the purpose ; but in India they present a special problem owing to the immense distances separating the broadcasting stations and the general unsuitability of the telephone lines and associated apparatus. All India Radio has consequently developed a system of wireless links whereby each broadcasting station is provided with a receiving centre equipped with special directional aerials for accepting programmes from the desired stations. These receiving centres are used principally for picking up the short-wave transmissions of All India Radio and of the B.B.C., and relaying these from the local transmitter. In the same way the news bulletins of the Central News Organization at Delhi will, as receiving centres are established, be received and relayed by all stations in the system. The main receiving centre on the outskirts of New Delhi was installed and working on a temporary basis just in time to relay the Coronation ceremony broadcast by the B.B.C. in May 1937. The installation utilizes a combination of three directional aerials for diversity reception to minimize the fading commonly experienced in short-wave broadcasting. The New Delhi receiving station also acts as a main control centre where a watch is kept on the wave-length, field strength and quality of the transmissions from stations of the All India Radio.

Among the more important activities of the research department of the organization is a study of the field strength of the transmissions from the various stations and of the service area of each station as determined by the ratio of the field strength of the signal to the strength of the disturbing noise. Much useful material on these subjects is given in the report under discussion, but only one or two outstanding points can be referred to here. One interesting fact emerging from the measurement of the field strength of the radiation from the various medium-wave stations is that the decrease in intensity of the ground wave with increasing distance from the

transmitter shows that the conductivity of the soil in India is of the same order as that obtained under average conditions in England (that is, between 1 and 2 × 10^{13} E.S.U. or 4,500–9,000 ohm-cm.). In addition to a study of ground wave conditions, measurements have also been carried out at night time on the indirect ray field strengths of the medium-wave stations. The results show that, with one or two exceptions that remain for further investigation, the relation between distance and field strength of these stations approaches the curve published by the C.C.I.R. (International Committee on Radio Communication), which is based upon a very large number of measurements made by broadcasting organizations in various parts of the world. This fact indicates that the conditions of medium-wave propagation through the ionosphere in India are not appreciably different from those in other parts of the world.

As already mentioned, the effective service area of a broadcasting station is determined by the ratio of the strength of the wanted signal to that of the unwanted noise. During the summer months of May–October, atmospheric disturbances represent the greatest single technical difficulty to be met with in India in providing a satisfactory broadcasting service, especially on the medium wave-length band. It is natural, therefore, to find that a considerable study is being made into the nature and origin of atmospheric disturbances. It is interesting to observe, however, that on the short wave-length bands, the service area of the Indian broadcasting stations is at present limited by the noise from electrical machinery and not by atmospherics. By far the most serious limitations on short-wave reception in India is the noise resulting from the operation of ceiling fans from a direct-current supply. In practically every city in India a D.C. supply only is available, and only in the large cities is a gradual change-over to alternating current supply being made. During the summer months, for a greater part of the twenty-four hours, there is a number of D.C. motor-driven fans in operation, and in many of these the commutator is in an unsatisfactory condition and hence causes serious disturbance.

As a conclusion to this review of the present state of broadcasting in India, reference will be made to a somewhat unusual activity of a broadcasting organization, namely, the design, supply and maintenance of a communal receiver for use by a considerable proportion of the rural population. From what has been stated earlier in this article it will have been appreciated that, apart from a few towns and suburbs, the broadcasting service in India is maintained by means of indirect rays propagated through the ionosphere, and if all-the-year-round reception is desired, the receiver must be one of the short-wave type, which is by no means cheap. The bulk of India's population live in villages, and it is considered that nearly 99 per cent of them cannot afford to buy any radio receiver, however reasonable its cost may be. The only solution to this economic difficulty appeared to be the installation of community receivers and the provision of special programmes for the villages. A number of such receivers has been installed by, and maintained at the expense of, the Governments of the individual provinces and are very successful.

As a number of difficulties were met with in the earlier stages of the inauguration of the village receiver scheme, a study of the technical points involved was made by the Research Department of All India Radio. After adequate investigation of the requirements, a specially designed receiver was evolved which, while following the general trend of commercial practice, incorporated certain additions and modifications. The receiver is of a straightforward superheterodyne type suitable for operation from a 6-volt car accumulator. In the comparatively few cases where an alternating current electric main supply is available a suitable alternative type can be provided. The two main requirements involved in the design of these receivers are reliability of operation and economy, since it is desired that they shall work automatically with only occasional attention by skilled technical personnel.

The receivers themselves are mounted in padlocked metal boxes, designed to keep out dust and insects. No controls appear on the outside of the box, and the receiver is left tuned to the local station. A clockwork-driven time-switch, incorporated in the set, switches the receiver on and off at the correct time for the "Village Hour" of broadcasting. Special attention has been given to the loud-speaker, which has been designed to have a high electrical acoustical conversion efficiency, to be free from the ravages of dust and moisture, and to give an adequate output of reasonable quality suitable for an audience of some two hundred listeners. The present type of receiver can be run from a medium-size car battery for a month on the basis of one hour's listening per day. Every three or four weeks the battery is charged and the clock re-wound. Installations of this type varying from fifteen to a hundred and twenty receivers in various provinces are in process of completion. In this manner, the full possibilities of community listening in numerous villages are being explored in an attempt to make broadcasting available to as great a proportion of the population of India as possible.

NEWS AND VIEWS

Islamic Culture in London

The announcement by Mr. G. N. Hall, Under-Secretary of State in the Colonial Office, in the House of Commons on November 13 that the Government at an early opportunity would invite Parliament to vote a sum not exceeding £100,000 for the purchase of a site for the erection of a mosque and centre of Islamic culture is one which has caused intense gratification to Moslems in Great Britain, and will be deeply appreciated throughout the Moslem world. The need has long been felt for an adequate centre of this kind at which Moslems in Great Britain might offer their prayers, develop Islamic culture and preserve their religious tradition. His Excellency Hassan Nashaat, Egyptian Ambassador in London, in announcing the gift by broadcast in Arabic "to my brothers in Islam" as reported in *The Observer* of November 17, appealed to the Moslem world for a sum of £500,000 towards the building fund, having previously given an assurance that this great centre of Islamic culture would belong to the whole Moslem world and would be controlled by its representatives irrespective of sect or denomination. The gift from the British Government, as was suggested in a reply by Mr. Hall to a supplementary question, in a sense is reciprocal to a gift from the Egyptian Government some years ago, when the site for a cathedral was presented to the British community in Egypt.

Conditions in Air Raid Shelters

The committee appointed jointly by the Minister of Health and the Minister of Home Security in September last, under the chairmanship of Lord Horder, made its first recommendations within a few days of its appointment and has continued to give advice from time to time. Further recommendations, with brief statements by the Ministry concerned of action already taken, have now been issued (London : H.M. Stationery Office. 2*d*. net). The Committee states that the crux of the problem is overcrowding, which should be countered by popularizing the domestic and communal shelters, and also by vigorously pursuing evacuation schemes already in operation. The other recommendations refer mainly to the provision of amenities, such as bunks, lighting and sanitary arrangements, and of first aid posts. On the thorny question of heating, the Committee points out that it is closely related to ventilation. The ideal solution would be air-conditioning, but as this is not practicable, ventilation by natural means is assumed. All ventilation shafts and other means for the entrance and exit of air should obviously be kept free, and floor draughts should be controlled by arranging for incoming air to be admitted at high levels so that it may mix with warm air. Shelters liable to crowding do not require heating even in winter, but sparsely occupied shelters might be heated during the latter part of the day-time. Air-borne infections may be reduced by spraying with a solution of sodium hypochlorite, and innoculation against diphtheria should be encouraged. A simple form of face mask would help to prevent the spread of droplet infection by coughing and sneezing.

Psychology in War-time

It is reported by Science Service that at a recent meeting of the South Psychiatric Association held at Jacksonville, Florida, Dr. C. Charles Burlingame, of Hartford, Conn., discussed the Nazi utilization of applied psychology in warfare. Dr. Burlingame pointed out that Hitler is mentally abnormal, but because he is a hysteric, it must not be assumed that his thinking is not lucid ; for he has successfully used the psychological factors of modern warfare to produce mass depressions and mass anxieties in whole nations. In dealing with him, the statesmen of the world have made the grave and tragic error of assuming that he was a normal man, whereas almost any psychiatrist would have known that he could not be expected to function or react in a normal way. Psychology can, however, make a positive contribution to the task of ridding the world of Nazism. In times of war, all the paranoid trends come to the surface ; in other words, the primitive brain which supplies the drive and co-ordinates the activities, but lacks the ability to formulate abstract principles, is apt to take charge. This is shown by outbreaks of persecutions and terrorism ; such outbreaks are a sign of weakness. Germany will grow progressively weaker as her hatred grows stronger and then suddenly transforms itself into despair and depression. It is the duty of psychiatrists to ward off such outbreaks. They can also watch for possible social gains in times of war ; many youths whom medical men would classify as 'unstable' might find a new life in the Army, where under intelligent discipline, with security and regular direction, they may become useful citizens.

Production of Feeding-Stuffs in Great Britain

Supplementing his study of Britain's supplies of feeding-stuffs from all sources (see Nature, Sept. 14, p. 362), Dr. Norman Wright has investigated quantitatively the problem of making good war-time deficiencies by using new sources of indigenous materials and by improved conservation of all supplies (*Agric. Prog.*, **17**, Pt. 2). He finds that conservation of all slaughter-house offals would only just offset the greatly diminished supplies of fish-meal, and that large-scale utilization of kitchen waste would provide a mere fraction of our requirements. Of greater significance is the officially projected production of one million tons of grass silage, but this amount would involve the construction of about 30,000 silos, each of 30–35 tons capacity ; and if ten per cent of the straw not used for stock-feeding were converted into a digestible cellulosic feed by predigestion with alkali, more than 20,000 digestion tanks and about 22,000 tons of caustic soda would be required.

Neither the direct use of urea or ammonium bicar-

bonate to make good the protein deficiency in cereal and other starchy foods, nor the doubling of the existing acreage under beans, would appreciably add to our resources in protein materials. More hopeful would be the economizing of imported feeding-stuffs by adopting the Lehmann system of pig-feeding (restricting the cereal meals and using more boiled roots, potatoes, etc.); the reduction in the protein ration of dairy cows from 0·6 lb. to 0·5 lb. protein equivalent per gallon of milk; and by putting all poultry on minimum feeding allowances. These savings would represent about three times those to be secured from possible new sources of supply. The total savings from all sources would represent 11·7 per cent protein equivalent and 8·9 per cent starch equivalent of our pre-War home production, but only 8·5 and 6·9 per cent, respectively, of our total pre-War supplies.

The Pharmaceutical Society's New House

The Pharmaceutical Society's building in London was nearing completion when the exigencies of the War brought about a suspension of the final stage of the building operations, and so prejudiced the intention of celebrating the centenary in a new home. The council of the Society, having in mind the fact that the lease of the old building in Bloomsbury Square will expire in due course, is approaching the Ministry of Works with the proposal that, in return for facilities being granted to finish the building, the Government should have the option of the use of it during the present emergency. This offer may raise the general question of the attitude of the Government regarding large modern buildings in London which are nearing completion.

The Society's new building has a frontage of 235 ft. and a site depth of 120 ft.; it is designed to provide a basement, ground floor and five upper stories, and the total available floor area which could be provided would be more than 141,000 square feet. The main front block and the west and centre wings have been erected up to the fourth floor level. The east block remains to be built from above basement level. The building is of steel frame construction with panel walls finished on the outside in brickwork with stone and slate dressings; the floors are of reinforced concrete. Since the accommodation contemplated covered the provision of laboratories, two lecture theatres, an assembly hall, library, refectory with kitchen and administrative offices, there are available large open and well-lighted floor areas readily adaptable to office or other similar requirements.

Germany's Aluminium Industry

The *Engineer* is publishing a series of illustrated articles entitled "Air Force Targets in Germany", in which much information is given about the docks, harbours, canals, factories, railways and power stations which are so often in the news. Three of the latest articles to appear, published respectively on October 18 and 25 and November 1, deal generally with Germany's aluminium industry and especially with the large works at Lauta, to the north-west of Dresden, at Bitterfeld in the Leipzig district and at Rheinfelden in the extreme south-west of Germany. The last is the oldest works, having been started in 1898, while the other two were planned in 1915–17 to meet the needs of the time. Each of the works consist of three main sections; an electric generating and transforming station, factories housing the groups of electrolytic baths or furnaces and foundries in which the metal is cast into ingots and bars and rolled into sections and sheets. The raw materials needed for the production of one ton of aluminium are 4 tons of bauxite, 80 kilos of artificial cryolite, about 600 kilos of carbon electrodes, and some 23,000 kw. of electric energy. The process time varies from 100 to 130 hours. In 1929 Germany's output of aluminium was 33,000 metric tons out of a world total of 282,000 tons and by 1938 it had risen to 163,600 tons out of a world output of 579,900. More than 70 per cent of Germany's light alloy manufacturing capacity is Government owned, and every effort has been made to extend the use of these light alloys and to manufacture them from home-produced raw materials.

Telegraphic Typesetting

A paper on telegraphic typesetting by H. H. Harrison read and discussed before the Institution of Electrical Engineers appears in the *Journal* of the Institution of October. In the discussion, Mr. D. Murray pointed out that the paper is valuable because it reminds us that, in addition to strong stream and weak stream technique, there are controlling electro-mechanisms of the most remarkable character, correctly described as electrical typewriter-keyboard machines, of great complexity and beauty. The teletype, one of these keyboard machines, of which the fundamental characteristic is the transmission of intelligence by semi-mechanical machines (telegraph class of mechanisms), is in wide use in the form of a telegraph exchange, analogous to a telephone exchange, covering the whole of the territory of the United States, with about 15,000 subscribers. Considerable progress was being made in this direction in Great Britain also, and plans were being considered for spreading the exchange all over Europe. Unfortunately, this development has been interrupted by the War.

Mr. Harrison's paper deals with an astonishing extension of the telegraph-keyboard mechanism that combines the typewriter-keyboard mechanism with typesetting at a distance. Mr. Murray saw it in operation at the Western Electric Teletype factory in Chicago about three years ago. It was shown to him as an example of successful prophecy, because about forty years previously he had exhibited a typewriter telegraph of this class at the old Astor House in lower Broadway with the slogan "This tape sets type". He had brought the model from Australia and it attracted much attention. In his reply, Mr. Harrison said that Mr. Murray's forty-year-old prophecy was an interesting example of the slow growth of ideas. Although the Monotype keyboard producing a perforated tape and provided with an

integrating counting mechanism was then available and was also as remotely situated from the type producer (the caster) as the present telegraphic typesetter keyboard, yet it is only comparatively recently that telegraphic typesetting has been accomplished.

Reducing Noise in Enclosed Spaces

DURING the last two years, progress has been made in the problem of noise reduction, especially in sound-proofing rooms against the transmission of external noise. In *Engineering* of October 25 the allied problem is described of sound-proofing rooms by using Accousti-Celotex tiles of sugar-cane fibre, manufactured by Messrs. Celotex, Ltd., Stonebridge Park, London, N.W.10. Under present-day conditions, many offices, etc., are more congested, with resultant increased noise. It is of interest, therefore, to cite certain data on sound absorption in offices which have recently become available. They are derived from tests made in the offices of an insurance company in the United States. This company has had about 300,000 square feet of Accousti-Celotex tiling fitted to its offices. Records were kept for a year preceding the fitting of the tiles and for a year after they had been installed. In two selected rooms, the increase of efficiency of the persons working therein was respectively 9·2 per cent and 7·7 per cent. Typists' errors were reduced by 29 per cent, and calculating machine operators' by 52 per cent.

It would appear that apparent loudness or annoyance increases much more rapidly at the higher loudness levels (in phons) than it does at the lower sound-levels, with the result that a relatively small reduction in phons at the higher levels decreases the apparent loudness very considerably. Thus it was found that a 7-phon reduction in a typing room with an average maximum loudness of 70 phons results in a decrease of 43 per cent in the apparent loudness or real annoyance, which condition is equivalent to the effect gained by the removal of about 80 per cent of the noise-making units. It is of interest to note that the tiles, from the material employed, are of light weight and are not affected as regards their sound-absorbing properties by painting. The grade of tile fitted in any particular case varies with the amount of noise normally present and the amount of absorption desired.

Mineral Resources of South Africa

THE Executive Committee of the Third Empire Mining and Metallurgical Congress, which met in South Africa in 1930, prepared for the Congress a review of the mineral resources of the Union of South Africa. The success which attended the issue of this book led to its revision in 1936, and now, in 1940, the Department of Mines has published a third and again thoroughly revised edition. Introductory chapters deal with the geography and geology and with various historical and legal aspects of the mineral industry; but the bulk of the work, which extends to 544 pages, is devoted to individual economic minerals, of which the chief, in order of total output, are gold, diamonds, coal, copper ores, tin ores, asbestos, silver ores and the platinum metals.

Recent expansion of mining activity in the case of gold has led to results which indicate that former estimates of the future life of the goldfields were below the true figure. The opinion now expressed is that unless gold materially decreases in value, the future of gold mining in South Africa is secure for many decades to come. Diamond mining has recently been almost at a standstill, apart from the alluvial fields; existing reserves are sufficient to maintain normal production for nearly a century. Similarly, there are immense reserves of platinum in the Bush-veld complex, and when prices become more favourable a great expansion of this branch of the industry is inevitable. Of coal and iron the Union possesses vast resources, coal being sufficient to provide for the needs of the country for many centuries. The book is copiously illustrated and well provided with maps and statistical tables, and will prove to be of great interest to a wide variety of readers.

Indian Association for the Cultivation of Science

THE annual report for the year 1939 of the Indian Association for the Cultivation of Science includes as an appendix a report by Prof. K. S. Krishnan on the scientific work of the Association. This has included investigations on the magnetic properties of a free-electron gas with the view of determining the energy distribution, and Pauli's observation of a feeble paramagnetism independent of temperature in the electron gas has been verified for several metals. Landau's discovery of the appreciable diamagnetism of an electron gas has been experimentally verified, and recent measurements by Prof. Krishnan and Mr. N. Ganguli have shown that the conductivity of graphite in the basal plane is at least 10,000 times that along the normal to the plane. Other investigations have related to the mobile electrons in aromatic molecules, the diamagnetism of aromatic molecules, optical studies on aromatic molecules, magnetic studies on bismuth in the neighbourhood of its melting point, and paramagnetic studies on single crystals of the salts of the rare earth and the iron groups of metals, as well as structural studies on organic crystals, including the halogen derivatives of benzoquinone and related compounds. Notes on some spectroscopic work on the sulphides of the transitional group of elements and on the discovery of a new ionization layer in the upper atmosphere are also included.

Replenishing the Fauna of the Caspian

As a first measure to replenish the fauna of the Caspian—a problem on which the Soviet Ichthyological Research Institute has been working for some years—Nereis, the Polychæte worm relished by the sturgeon, bream and other fish, is to be brought to this land-locked sea from the Azov. The worm will be transported from the Azov Sea in isothermal boxes and put into the Caspian. Experiments carried out during the past three years have proved the

possibility of transplanting certain species of invertebrates from the Azov to the Caspian. The Ichthyological Research Institute has decided to begin with the transplantation of Nereis, which is able to withstand changes in salinity and temperature and is unaffected by lower contents of oxygen.

Wilhelm Erb

Prof. Wilhelm Heinrich Erb, a pioneer in neuropathology and electrotherapy, was born at Winneweiler in the Palatinate on November 30, 1840. He received his medical education at Heidelberg, where he was assistant to Nikolaus Friedreich, and qualified in 1864. After working with Buhl at Munich on morbid anatomy, he was appointed extraordinary professor of special pathology and treatment at Leipzig in 1867 and full professor in 1880. Three years later he was transferred to the corresponding chair at Heidelberg, where he remained until his retirement in 1917. His first work was in connexion with toxicology, histology and therapeutics, but afterwards he devoted himself almost entirely to neurology. Erb's name, either alone or in association with those of other neurologists such as Duclenne, Charcot and Goldflam, has been given to several nervous diseases. He was also the first to describe the knee-jerk, independently of Westphal, and simultaneously with Fournier demonstrated the close etiological association between syphilis and tabes and general paralysis. He died on October 29, 1921.

The Night Sky in December

On December 22 the sun enters the sign Capricornus (the winter solstice). The night reckoned from sunset to sunrise then lasts 16¼ hours in the latitude of London. Full moon is on December 14 and new moon on December 28. At meridian passage soon after 0h. on December 15 at Greenwich, the moon's altitude is 57°. Jupiter and Saturn, the conspicuous pair of bright planets, are visible throughout the greater part of the night. On December 11, they are in conjunction with the moon at 1h. and 6h. respectively. (All times are given in Universal Time; add 1h. to convert into Summer Time.) Mars is a morning star rising about half an hour before Venus on December 15. These two planets are in conjunction with one another on December 2 at 12h. On December 25 at 18h., Mars is in conjunction with the moon, and Venus is likewise in conjunction on December 26 at 18h. The rapidly changing positions of Jupiter's four inner satellites, their transits and eclipses, may be followed from the data given on p. 630 of the *Nautical Almanac* or on p. 182 of *Whitaker's Almanack*. Saturn's unique ring system is well open; a refractor of 2 inches aperture or larger is, however, required to resolve the rings. The bright stars of Perseus, Auriga, Taurus and Orion (with Procyon and Sirius in train), bring glory to the December night skies. There are the open star clusters of Perseus, the Pleiades and the Hyades: many well-known double stars, variable stars and nebulæ in abundance. Near φ Tauri is a dark nebulous region which Barnard considered as giving the strongest proof of the existence of obscuring matter in space. Near the irregular variable star, *T* Tauri, is the remarkable object known as Hind's variable nebula. Two notable nebulæ, exemplifying two distinct types, are both visible to the naked eye on moonless nights during this month. These are the great nebulæ of Orion and Andromeda—the first a greatly extended diffuse nebula of radiating gas lying within our Milky Way system: the second, a vastly remote stellar system in itself, the prototype of many millions which are shown on long-exposure plates taken with the largest reflecting telescopes. At midnight on December 31–January 1, 1941, Sirius, the brightest star in the heavens, is within 2 minutes of the southern meridian of Greenwich.

Announcements

During a recent air raid, the Great Hall of the University of Bristol was damaged. The Great Hall is one of a series of magnificent buildings presented to the University by Sir George Wills and Mr. H. H. Wills, in memory of their father, the first Chancellor, and opened by King George V in 1925.

It is announced in *France*, the journal for Free Frenchmen published daily in Great Britain, that Prof. P. Langevin, who has just been awarded the Copley Medal of the Royal Society (see Nature, Nov. 23, p. 679) is now in prison.

Dr. G. Roussy, rector of the University of Paris and formerly dean of the medical faculty and professor of pathological anatomy, and M. Maurice Guyot, general secretary of the University, have been removed by order of the Vichy Government.

Dr. D. H. Peacock, professor of chemistry in the University of Rangoon and special chemical adviser (Customs) to the Government of Burma, is retiring from the service of the Government of Burma.

Dr. Dontcho Kostoff, of the Institute of Genetics, Academy of Sciences, U.S.S.R., has been appointed to a position in the Central Agricultural Experiment Station at Sofia, Bulgaria.

Mr. Harold Hartley has been appointed lecturer in mine surveying in the University of Leeds, in succession to Mr. T. Brown, resigned.

Mrs. J. R. Ogden and her family have presented to the Brotherton Library of the University of Leeds a large collection of lantern slides. These, added to the slides given by Mr. Ogden during his lifetime, bring the number in the Collection to more than five thousand. The slides deal largely with Palestine and Egypt, and include more than four hundred slides on the tomb of Tutankhamen.

It has been found necessary to close the Museum of the Royal College of Surgeons until further notice. Those who wish to present specimens to the Museum should retain them in their possession, but should notify the Curators of their intention to present them at a later date.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

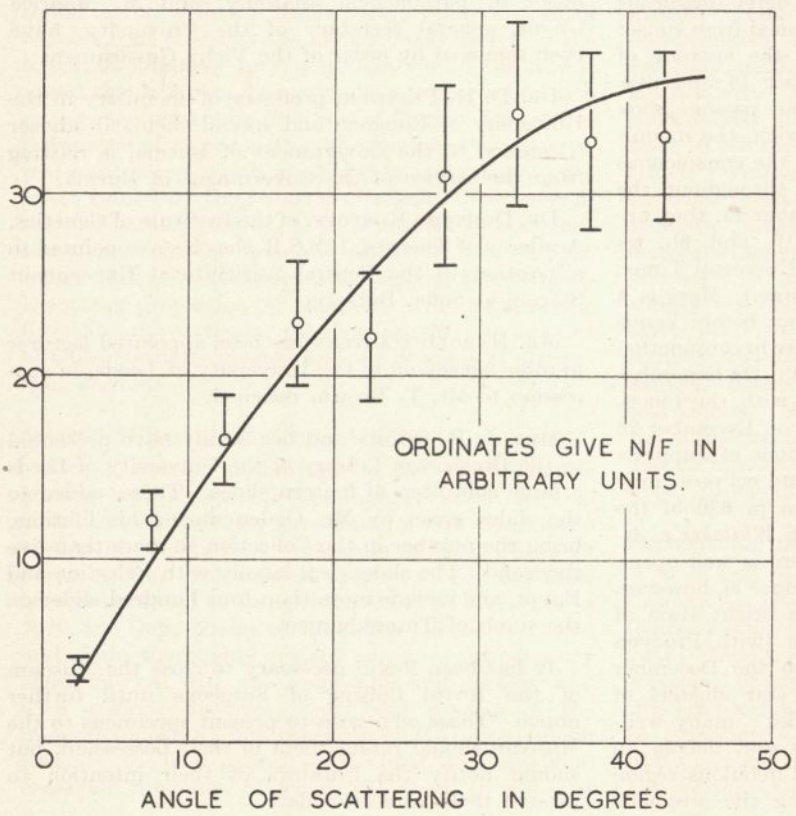
Neutron-Proton Scattering at High Energies

THE angular distribution in the scattering of neutrons by protons has been investigated by a number of observers, particularly Dee and Gilbert[1], using neutrons with an energy of approximately 2·0 eMv. It is now generally agreed that the scattering is isotropic about the centre of the mass of the colliding particles with neutrons of this energy. We have recently investigated the scattering at much higher energies, using the 8·7 eMv. group of neutrons coming from boron under deuteron bombardment.

In a recent communication[2], one of us (C. F. P.) has shown that it is possible to measure the angle of dip of a proton track in a photographic emulsion relative to the plane of the emulsion, and hence to determine the spacial orientation of the proton track, with an accuracy of $\pm$ 1°. Attention was directed to the fact that this technical advance makes it possible to apply the photographic method to the determination of the spacial distribution of the protons arising from the photo-disintegration of deuterium by a directed beam of monochromatic γ-rays, and to the investigation of neutron-proton scattering at high energies. For the present experiments we passed the neutrons from a highly localized source, produced by bombarding a boron target by a 500 kv. deuteron beam 3 mm. in diameter, through a 'half-tone' emulsion 100 μ thick and in a direction parallel to the surface. Some of the neutrons make close collisions with the protons provided by the combined hydrogen in the emulsion and project them forward at various angles with the direction of the original neutron stream. We require to determine the distribution in angle of these protons relative to the direction of the neutron stream.

We first determined the range and orientation of all the distinguishable tracks of range greater than 15 cm. of air, present in 50 mm.^{2} of the emulsion, which began and ended in the emulsion. 1,500 tracks were so measured, and of these, those tracks were chosen which had such a range and angle of scattering that their production could be definitely ascribed to the 8·7 eMv. neutron group. The method of deciding which energy group of the neutrons coming from the bombarded boron is responsible for a given track has already been described[2].

From these tracks only those were retained in which the inclination of the track to the plane of the emulsion, the angle of dip, β, was less than 10°. We were left with 400 tracks.



The number of tracks so chosen for which the angle of scattering lies between two given values evidently does not represent all the tracks in the measured area of the emulsion which have been scattered in this range of angles. Tracks will be neglected for two reasons :

(*a*) There is a rapidly increasing chance of failing to recognize tracks for which the angle of dip, β, is greater than 15°. The limitation $\beta = \pm 10°$ is therefore applied to avoid introducing uncontrolled errors.

(*b*) A certain fraction of the projected protons do not end in the emulsion but enter the glass of the plate or pass out of the surface of the emulsion. Such tracks cannot be definitely ascribed to a particular group of neutrons and are ignored.

We have thus defined the conditions in which a track is accepted. Of all the tracks produced by a neutron group of a certain energy and scattered within a given range of angles, a fraction F will be counted ; S/F can easily be calculated, from the thickness and stopping power of the emulsion, for neutron groups of different energy. If N tracks are observed to be scattered in a given angular

range by a group of neutrons of a particular energy, then the total actual number of such tracks in the emulsion will be given, within the limits of the statistical error, by the quantity N/F. From the observed distribution of number with angle, we can therefore calculate the distribution to be expected if all tracks were measured.

The results of our measurements are shown in the accompanying figure, in which the number, N/F, of tracks in successive intervals of 5° in the angle of scattering are shown as circles, the vertical straight lines through the circles indicating the extent of the probable error. The distribution calculated on the assumption that the scattering is isotropical about the centre of mass of the colliding particles is indicated by the continuous line. It will be seen that the experimental values are consistent with this assumption. We may therefore conclude that the scattering departs very little, if at all, from pure '*s*' scattering at 9 eMv.

It is evidently desirable to make similar investigations at higher energies, and our experience shows that this should be possible with the present methods at energies up to at least 15 eMv.

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Nov. 5.

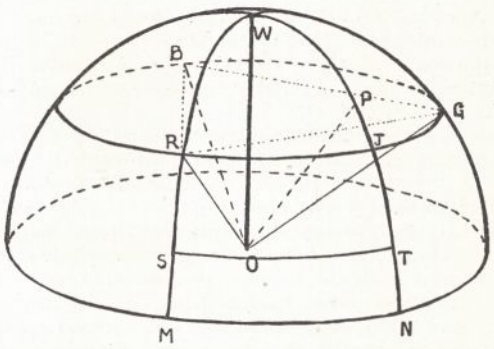
[1] Dee, P. I., and Gilbert, C. W., *Proc. Roy. Soc.*, A, **163**, 265 (1937).
[2] Powell, C. F., Nature, **145**, 155 (1940).

Colour Vision and Chromaticity Scales

In a recent issue of Nature[1], Dr. W. D. Wright has given a very clear and interesting account of recent work in the direction of commercially practical application of measurement in the matching of colours, and in their analysis or synthesis. On the practical side the first steps were taken independently by Helmholtz and Maxwell in the employment of spectrum standards—always reproducible. By means of these, other standards, more normally attainable, more readily and simply usable by scientifically untrained workers, can be brought into employment.

The problem is simplified by the plan, first used by Maxwell, of keeping the intensity constant. Only two independent variables are then present, and so a pictorial representation of results can be made in two dimensions—in particular, on a plane. Dr. Wright discusses two such representations specially. As he points out, the great trouble in all these is that of getting a scale uniform in all stages of colour variation. Approximation to that state is all that can be attained.

My object here is to inquire if a different mode of procedure, first indicated by Helmholtz, might not be worthy of consideration. It consists in the use of the sensation space instead of the stimulus space. The accompanying diagram represents the construction, which employs a hemisphere with centre *O*. *OW* is a vertical radius, perpendicular to the circular base surrounding *O*. The distant viewpoint is in a direction inclined slightly above the base. The small circle *RGB* is parallel to the base, and *OR*, *OG*, *OB* are three mutually perpendicular lines, all equally



inclined to *OW*, which may be taken as the usual axes of stimulus co-ordinates. The triangle *RGB* corresponds to the plane colour triangle of Maxwell, as used by him and Helmholtz. We can lay down on the plane of the triangle the spectrum curve in manner analogous to that used in the two diagrams dealt with by Dr. Wright.

Alternatively, we may consider Helmholtz's other representation by the sensation field. The line *OW* is the line of colourless (white) sensation. Any small (latitude) circle surrounding *OW* as polar axis is a curve of constant *whiteness* or constant *saturation*. Any longitude line is a locus of constant *hue*, more or less white. Constancy of the radius of the sphere corresponds to constancy of *intensity*, which is the third independent constituent quantity in luminous sensation. But the particular function of the radius which is used to express the intensity of a sensation has to be determined in accordance with Abney's law. This, and the fact that Fechner's law holds as a good first approximation, compel, as Pauli first pointed out, the adoption of the square roots of the stimuli as the component quantities to be measured along the axes *OR*, *OG*, *OB*. Thus the spectrum sensation curve can be drawn on the surface of the sphere.

The simplest law that we could postulate for the dependence of saturation changes and hue changes, in proceeding from one point to another on the sphere, is that of direct proportionality to the latitude and longitude changes involved. Thus increase of saturation would be taken to be proportional to increase of polar distance from *W*; and increase of a hue constituent would be proportional to increase of angular distance measured round *OW*. But the change of hue must also be proportional to the polar distance from *W*; for, when this is vanishingly small, rotation round *W* gives vanishingly small change from *W*, that is, vanishingly small change of hue. Thus the simplest expression for change of hue would be that of joint proportionality to longitude difference and latitude difference.

These are actually the laws, as Schroedinger first showed. A short deduction, by quaternionic treatment, has been given in Nature[2]. The first of the three terms in the last equation given on that page vanishes by the condition of constancy of intensity assumed here. (Towards the foot of the last column there, the first term on the right-hand side of the equation for Q' should read $2\,S \log q$.)

Let *OP* be the colour vector the difference of which from *OR* (standard red) is to be expressed. It is proportional to the great circle arc *MN*. So if we lay off *SM* or *TN* equal to *PJ*, the difference of hue sensation is proportional to the area of the spherical

rectangle *MNTS*. With latitude and longitude arcs drawn sufficiently closely on the sphere to form a suitable scale, this gives a very easy estimate of the difference of hue; similarly, in the case of any two colour vectors *OP*, *OP'*.

The outstanding difficulty, referred to by Dr. Wright, of getting a uniform chromaticity scale, remains. But it seems to me that the fact of the angular spread of the spectrum curve of sensation, amounting to 240° in the sensation space, as compared with 90°, or a little more, in the stimulus plane space, may indicate a considerable advantage.

In all adjustments taking place in the work of colour matching, it is equalization of sensation (hue or saturation) that is the direct aim. So this method of representation is very direct. Whether it be really superior to the representation used hitherto or not, I cannot judge, from want of familiarity with the practical needs. It would be of value to have Dr. Wright's view on the whole matter.

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[1] NATURE, **146**, 155 (1940).
[2] NATURE, **124**, 791 (1929).

IT would, as Prof. Peddie suggests, be possible to approach the problem of a uniform chromaticity scale from the point of view of the sensation rather than the stimulus. An investigation[1] somewhat along these lines is in fact in progress in connexion with the spacing of the colours on the Munsell system. But for ordinary colorimetric purposes, it is desirable that the distribution of colours should possess the geometrical relations characteristic of the trichromatic colour triangle, and to ensure that, the stimulus approach appears to be essential.

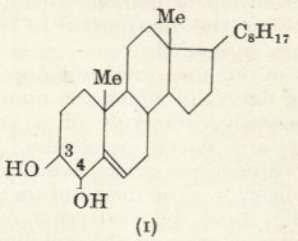
Further, I fear that the laws relating stimulus and sensation are so open to question, that a colour solid based on them would be unlikely to stand the strain of practical usage; instead, the solid would have to be derived from fresh experimental observations of colour differences, as in the case of the Munsell system. It might happen that identical colour distributions would be obtained whether the stimulus or the sensation approach were employed, but I can see no theoretical reason why this should occur, nor, so far as I know, is there any experimental evidence suggesting such a fortunate contingency.

W. D. WRIGHT.

[1] Newhall, S. M., *Amer. J. Psych.*, **52**, 394 (1939).

Formation of Insoluble Digitonides of Cholesterol Derivatives

IN the course of an investigation of 6-chloro-3-benzoyloxy-$\triangle^4$-cholestene[1], we have isolated a monobenzoate (m.p. 153–154°) of *cis*-3 : 4-dihydroxy-$\triangle^5$-cholestene (I) which differs considerably from the monobenzoate (m.p. 209–210°) of the *cis*-diol prepared by the method of Rosenheim and Starling[2]; the latter has been accorded the 3-monobenzoate structure on the seemingly substantial evidence that the *cis*-diol (I) gives an insoluble digitonide, whereas the monobenzoate, m.p. 209–210°, fails to do so. To test the implication that the new ester, m.p. 153–154°, is the 4-monobenzoate, its reaction with digitonin was examined. It fails to give a digitonide using standardized conditions which effect immediate precipitation of the digitonides of cholesterol and the *cis*-diol (I). It follows that the formation of one of the monobenzoates of the *cis*-diol has been accompanied by the migration of a benzoyl-group from the C_3- to the C_4-hydroxyl, and although such migration appears to be less likely in the case of the monobenzoate m.p. 209–210°, the exact location of the esterified hydroxyl group in the mono-esters[3] remains to be rigidly established. Furthermore, it is clear that the introduction of a C_4-*cis*-benzoyloxy-group into cholesterol prohibits the digitonin reaction.



(I)

F. S. SPRING.
G. SWAIN.

The University
Manchester.
Nov. 1.

[1] Spring, F. S., and Swain, G., *J. Chem. Soc.*, 1356 (1939).
[2] *J. Chem. Soc.*, 377 (1937).
[3] (Added in proof). Dr. O. Rosenheim informs us (private communication) that he has prepared the hitherto unknown 4(?)-monoacetate of the *cis*-diol which, as we find is the case with the 3(?)-monoacetate, fails to give an insoluble digitonide.

A Non-Historical Eclipse

IN John Evelyn's "Diary", under the date October 14, 1688, there is a record of an eclipse of the sun. Now it is quite true that an eclipse took place, but this was not visible in any part of Europe. The central line passed very far south, and even the limit of the partial phase came only a few degrees north of the equator near its farthest extension to the north and west.

The reference to the eclipse consists of a sentence of only six words, which has much of the appearance of being a subsequent insertion. That is probably what it is, as the diarist can only be stating what some other person told him, and thus there is reason for concluding that some traveller from rather distant regions supplied the information at a later date. It is difficult to think of an answer to the problem of who the observer can have been.

The rest of the entry in the Diary states that the day was a Sunday, and prayers were offered in the churches for protection from invasion. This naturally attracts attention, but the reference is merely to Prince William of Orange, for whose arrival many Englishmen "were passionately longing".

These are Evelyn's own words, and the use of the past tense is further evidence of the fact that he was making insertions at a later date. On the third Sunday after that, the Prince, favoured by a "protestant wind", sailed into a British seaport; and he found the men of Devon willing to give him plentiful assistance in landing.

C. J. WESTLAND.

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Sept. 1.

RESEARCH ITEMS

Early Chinese Lacquer Toilet-Boxes

Two pieces of outstanding importance from the last of the Eumorfopoulos collection have been presented to the British Museum; one, a Chinese lacquer toilet-box, purchased by the National Art-Collections Fund, and the second, the blue splashed T'ang pottery horse which was the late owner's special favourite, presented by Mrs. G. Eumorfopoulos in memory of her husband (*Brit. Mus. Quarterly*, **14**, 3; 1940). In a description of the two pieces by B. Gray, the lacquer box is stated to be much the most important piece of Early Chinese lacquer to have left the East. It is remarkable for its fine state of preservation and for unique features of its decoration. Judging from finds made by Japanese archæologists in Korea, painted lacquer was the most usual material for articles of luxury in the Han period, after Chinese taste had changed about 600 B.C. from an interest in plastic form to a preference for enrichment of surfaces. In the 'Hwai-style period' inlay was extensively used to enrich the bronzes; but in the Han period a freer technique of painting came into fashion. Though also tomb furnishings, the lacquer boxes, tables and utensils must certainly have been used by the owners before death. In the tombs of Lo-lang of South Korea, of the considerable number of lacquer objects found, the most important are the toilet-boxes. These are of three main shapes, small oblong, high rectangular with coffered lids, and circular boxes with domed lids. Although several are inscribed as having been made in Szechwan, until lately no piece was known to have been found on Chinese soil. The present example, however, is said to have been found in a tomb at Haichow in the northern part of Kiangsu near the old bed of the Yellow River. It resembles generally the round toilet-boxes found at Lo-lang, but has important differences, and it differs in the style of the painted decoration. In consequence it has been assigned to the third century B.C. This is before the period to which the Korean boxes all appear to belong in the first century A.D. Probably the true date is somewhere between the two.

Parasites of the Oriental Fruit Moth

Circular 561 (June 1940) of the United States Department of Agriculture is devoted to an account of the importation, rearing and colonization of various parasites of the oriental fruit moth (*Grapholitha molesta*). The authors, H. W. Allen, J. K. Holloway and G. J. Haeussler are officers of the U.S. Bureau of Entomology and Plant Quarantine. Since about 1923, when this moth became a formidable pest in the eastern States, a good deal of consideration has been given to its control by means of parasites. The reason for this emphasis has been the absence of generally accepted artificial means of control and the great reduction in the insect's destructiveness in some areas where heavy parasitization by indigenous parasites prevails. Much of the parasite work is centred in a special laboratory at Moorestown, N.J., where extensive rearing of imported parasites has been carried out. Of these latter, seven are European species, two Australian and seventeen from China and Japan. One of the most important phases of the work has been the multiplication of the indigenous parasite *Macrocentrus ancylivorous* and its colonization throughout the area infested by the moth. The breeding for colonization of six of the principal imported species was also a major aspect of the work. It is noteworthy that no satisfactory results have been obtained by the propagation and liberation of the indigenous egg-parasite, *Trichogramma minututum*. It has not yet been possible to make recovery tests from a large proportion of the parasites liberated in different areas affected by the moth. From such recoveries that have so far been made the indications are promising, and several species have multiplied rapidly immediately following their release.

Heterosis

I. N. Sveschnikova (*J. Hered.*, **31**, 349–360; 1940) has analysed the chromosome constitution, vigour and other characters in hybrids between species and varieties of Vicia. It is believed that there is a relation between the length of the chromosomes *A*, *F* and *E* and the growth of definite quantitative characters. This relationship can be explained by the existence of additional genes due to duplication of parts of the chromosomes. There is a gradual change in the homologous chromosomes in the closely related species *V. amphicarpa*, *sativa*, and *angustifolia*. Thus the *A* and *F* chromosomes progressively increase in length from *N. amphicarpa* to *V. angustifolia doliochosomica*, while basal branching of 2–3 branches in *amphicarpa* increases to 20 in the last variety, and the bending-back of the standard and wings similarly increases in degree in the species. Hybrids between a race of *V. angustifolia brachisomica* and *V. a. doliochosomica* show 150 per cent increase in height over the parents. On the other hand a different race of *V. a. brachisomica* in a similar cross gave dwarf, stunted plants. Other species-crosses support the view that genes for growth are combined in the species hybrids and that plus-heterosis or minus-heterosis (depressed vigour) may be produced. Sveschnikova also notes that dominance as well as heterosis is more pronounced in species with the longer chromosomes. Segregation in second generation hybrids gives results expected on this hypothesis.

Earthquakes during October

During October last, five distant earthquakes were registered at Kew Observatory. The first, on October 1, had an amplitude of 25 μ at Kew, and the second, on October 4, probably the largest in the month, gave a ground amplitude of 110 μ at Kew, being estimated at an epicentral distance of 10,260 km. The third, on October 11, probably 12,300 km. distant, gave a ground amplitude of 78 μ at Kew, whilst the fourth, on October 22, may have originated 2,040 km. away. On October 27, an earthquake, probably at an epicentral distance of 8,720 km. from Kew, commenced registration with a compressional wave at 5h. 47m. 39s. at Kew, and at its maximum attained an amplitude of 39 μ there. This latter record, however, was disturbed by irregular long-period waves which had been noticeable through-

out the day. A further earthquake was recorded by the Bombay Observatory on October 5 and was thought to have had its origin in Tibet. Early on October 11, the region around Los Angeles and Hollywood was shaken by a tremor felt for 10 seconds, though no damage was reported. The Rumanian earthquake of October 22 has been reported previously. Late on the night of October 26 an earthquake rocked the Republic of Costa Rica in Central America, causing some apprehension, though again no damage has been reported.

Earthquakes Registered in Switzerland

DURING July 1940, nineteen earthquakes were registered at the Swiss observatories of Basle, Chur, Neuchâtel and Zurich. The shock of July 1 was in the Azores and that of July 6 in the West Indies. The deep-focus shock of July 10 (*ca.* 550 km.) was in the region of Tibet, and that of July 14 in the Aleutian Islands. The earthquakes of July 26, 27 and 31 were respectively in the Jura, Central America and Anatolia. During August, sixteen earthquakes were recorded. On August 4 the epicentre was near Simplon and on August 6 in the Swabian Alps near by. The shocks of August 16 and 22 were in Asia Minor and the Aleutian Archipelago respectively, all the epicentres being determined at Zurich.

Seismological Observations at St. Louis

BETWEEN June 5 and August 1, 1940, twenty-three earthquakes were registered on seismographs throughout the United States of America belonging to the Jesuit Seismological Association. At the central station at St. Louis, J. B. Macelwane, *S.J.*, and his colleagues evaluated the initial time, epicentre and depth of focus of the twelve most intense of these from all the records available to them. Besides their own, these included records from stations belonging to the United States Coast and Geodetic Survey and private observatories. The shock of June 5, on a basis of twenty-one records, had its epicentre in north-west Canada, and that of June 17 originated in the Pacific Ocean north-east of Hawaii. The second shock of June 23 originated in the Gulf of California. On July 6 there was an earthquake near the Windward Islands, while the shocks of July 10, 13 and 14 were centred in Manchuria, near Panama, and in the Aleutian Islands respectively. The earthquakes of July 19, 20, 27 and 30 had epicentres in the Aleutian Islands, near Samoa, near Guatemala, and in Anatolia respectively, and the shock of August 1 had its epicentre in the Sea of Japan between the Japanese islands and the mainland. The deepest focus shock was that of July 10, near 550 km., and other deeper than normal shocks were on July 6 (160 km.), July 14 (80 km.), and July 27 (100 km.). All the determinations are said to be tentative.

Ionization of the Lower Atmosphere

IN the *Proceedings of the Royal Irish Academy* (**46**, Section A, No. 7 ; 1940) J. J. Nolan adds another paper to his many contributions to the study of the ionization of the lower atmosphere. It is pointed out that concentrations of small ions in the atmosphere of the order of 2,000–2,500 per c.c., obtained from the equation for equilibrium of ionization in a pure gas, that is, $dn/dt = q - \alpha n^2$ where n is the concentration of small ions of one sign (positive and negative being assumed to be equal), q is the rate of production of ion pairs per c.c. and α is the coefficient of recombination between positive and negative small ions, are very rarely met with in the atmosphere, while in cities n can fall below 100 owing to the attachment of ions to Aitken nuclei. The author goes further into the subject, discussing relevant observations, made in various parts of the world, including Australia and Java, and suggests that the equilibrium of small ions at any place in the lower atmosphere is represented by the equation $q = an + bnZ$, where n and Z are the concentrations of ions and nuclei, a being apparently constant under normal conditions, while b depends upon the nature of the nuclei present.

Solubility of Lead Salts

THE solubility of lead sulphate in ammonium acetate solution is a well-known reaction in analytical chemistry. It has been attributed to the formation of undissociated lead acetate (Noyes and Whitcomb, *J. Amer. Chem. Soc.*, **27**, 747 ; 1905) and to the formation of an acetoplumbite complex ion (White, *Amer. Chem. J.*, **31**, 4 ; 1904). Sanved (*J. Chem. Soc.*, 2967 ; 1927), from the increased solubility of lead acetate and other lead salts in alkali acetate solution, concluded that the ion formed is probably $Pb(C_2H_3O_2)^+$, a result of the primary dissociation of lead acetate ; but the experimental results were obtained with high and varying salt concentration, where the application of the law of mass action could only be qualitative. S. M. Edmonds and N. Birnbaum (*J. Amer. Chem. Soc.*, **62**, 2367 ; 1940) have determined the solubility of lead iodate at constant ionic strength in presence of varying acetate ion concentrations. The results are interpreted in terms of a complex ion $Pb(C_2H_3O_2)_n^{+2-n}$ and the slope of the curve shows that $n = 1$. Hence the complex ion is $Pb(C_2H_3O_2)^+$ and it may be inferred that the same product is formed from lead sulphate. Of the two alternative explanations, the formation of a complex ion seems, therefore, more probable than the production of undissociated lead acetate.

Trimethylcarbinol as a Cryoscopic Solvent

As a cryoscopic medium of moderate solvent power and having a melting point not far removed from room temperature trimethylcarbinol seemed to have the desired properties. The cryoscopic constants of this substance are, however, very discrepant. In a new investigation by F. H. Getman (*J. Amer. Chem. Soc.*, **62**, 2179 ; 1940) it is shown that by a suitable experimental procedure a sample of trimethylcarbinol having a steady melting point can be obtained ; the freshly distilled solvent is removed to a room at a temperature considerably lower than its freezing point 25·1°, thus preserving it in the solid state except when required for use. The melting point then altered only slightly with time. A series of thirty solutes was used and the freezing point concentration curves were drawn. The slope of each curve at the origin gave the cryoscopic constant K. Apart from cases where interaction between solvent and solute occurred the mean value of K was 8·37, whereas the value calculated from one of the discrepant heats of fusion (21·88 cal./gm.) is 8·15. The use of trimethylcarbinol is thus shown to be entirely satisfactory as a cryoscopic solvent, provided due care is used in its preparation and preservation, and it is particularly useful when a melting point not far removed from room temperature is desired.

FERTILITY IN FLEMISH AND SMALLER TYPES OF RABBIT

By W. King Wilson,

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THE Flemish Giant is the largest breed of rabbit, and at first sight it would appear to be the most important breed for meat production. In practice, however, there is a relative scarcity of breeders who persevere with studs of typical Flemish. (It is essential to distinguish between typical Flemish, as described in the standard, and the many crosses which are often loosely described as 'Flemish'. The reasons appear later.) The standard for the Flemish Giant[1] specifies a large animal of steel-grey colour with white belly fur. No other colour is recognized in Great Britain; but in other countries a wider range is admitted. For show purposes the standard weights of adults are: bucks 11 lb. or more, and does 12 lb. or more; in 'intermediate classes' they must be less than the above weights. Whilst allowing for difficulties in securing great size and weight, together with all the other points required in show stock, the fact that there are not more breeders of a rabbit of this size suggests that there must be some underlying drawbacks.

Flemish Giants represent remarkable development and size improvement over the wild ancestor, amounting to some 300–500 per cent increase in weight over the original stock. It has been pointed out that the higher the level of production the greater the strain in maintaining that level[2], and finer adjustments are needed at the higher plane of nutrition. Furthermore, large breeds tend to have more young to the litter than small breeds[3,4]. Great size and weight though heritable are unfortunately not due to a single dominant factor, but are due to multiple factors[5,6,7,8]. This large size is of national importance for meat production in war-time. The fur colour of Steel Flemish[9] was not found to be so difficult to produce as earlier investigators had indicated from work with other varieties of steel rabbits[10,11,12,13,14]. The pelt is practically as large as that of the silver fox animal.

One of the difficulties of producing typical Flemish Giants is that they often tend to be slothful and difficult to mate when kept on the usual mixed ration. Close inbreeding for five generations was reported to have resulted in complete sterility[6]; but similar results also occurred with an inbred small breed. Hammond has published the histories of sterile Flemish bucks and does and has fully described their histological condition[15]. Some individuals are particularly troublesome, but may sometimes be assisted by appropriate handling. This disinclination to copulate, and the number of infertile matings, is very marked by comparison with the smaller and intermediate breeds. Both the latter are much more popular with breeders.

During last winter the severe frosts prevented the use of green foods for approximately two months (January and February) and roots were generally too frosty for use. Over a period of eight weeks the stock received an average of only one feed of roots or beet pulp weekly. It should therefore be interesting to compare the fertility of Flemish and smaller breeds during this and the immediately ensuing breeding season.

Experimental

The stock was divided into three main groups comprising (*a*) Flemish and first cross Flemish does; (*b*) brown Beveren type does; and (*c*) Dutch does. There were thirty-two to thirty-four matings, or attempted matings—by putting the doe to the buck—in each group. Fertility of does in the different breeds is shown below:

Table 1. Fertility of Flemish and Smaller Types.

Breed	Flemish	Flemish first cross	Combined	Beveren type	Dutch	Total
No. matings attempted	21	13	34	34	32	100
No. litters	9	12	21	31	28	80
Per cent fertile	42·86	92·31	61·76	91·18	87·50	80·00

The fertility was good in Beverens (91 per cent) and Dutch (88 per cent), the latter's average being reduced by one doe which required 3 matings to become fertile. The well-bred typical Flemish stock gave a very poor level of fertility (43 per cent); but in striking contrast to this the first cross Flemish does were practically always fertile, with 12 litters from 13 matings, or 92 per cent. The F_1 does consisted of seven matings from large × large type (Flemish × Belgian) does, which produced six litters; and six matings of large × small type (Flemish × Tan) does which produced six litters. Thus it appears that the type to which the Flemish is crossed is immaterial, and regardless of the size of breed used for the outcross the F_1 show remarkable improvement in fertility over typical Flemish stock.

The average litter size from these different groups did not provide any large differences in the number of young:

Table 2. Litter size from Flemish and smaller types.

Group	Flemish	Flemish first cross	Combined	Beveren type	Dutch
No. of litters ..	9	12	21	31	28
Average number of young ..	5·22	5·08	5·14	5·19	5·43
Range	2–11	1–8	1–11	2–8	1–9

The litter size for Flemish was lower than usual, although the largest litter (eleven) was produced by this breed. The average for F_1 does was also lower than expected; the Flemish × Belgian was only 4·50, whilst the Flemish × Tan was 5·67 per litter. The Flemish had the greatest range of litter size, and the Beveren had the narrowest, as shown in

Table 3. The Dutch maintained a good average, for their size, at 5·43 per litter, which is explained by nineteen of these litters being from outcrosses averaging 5·58, whilst the average from Dutch × Dutch matings was 5·11. The range for Dutch × Dutch litters was 4–7 but was more than doubled when outcrossed, ranging from 1–9 young, which, surprisingly, is greater than from the larger type does from the Flemish outcrosses.

TABLE 3. DISTRIBUTION OF LITTER SIZE BY BREED.

Litter size	Flemish	Flemish first cross } Combined	Beveren type	Dutch	Total
1	–	1	1	–	1	2
2	1	2	3	2	1	6
3	2	1	3	3	–	6
4	–	–	–	5	7	12
5	4	2	6	5	5	16
6	–	2	2	6	6	14
7	–	1	1	8	5	14
8	1	3	4	2	2	8
9	–	–	–	–	1	1
10	–	–	–	–	–	–
11	1	–	1	–	–	1
Total	9	12	21	31	28	80

A guide to the weight of different groups of does is taken from their live weights during lactation at approximately the time when the young began to leave the nest: Flemish, 9 lb. 6 oz.; Flemish and first cross, 8 lb. 13·13 oz. (Flemish × Belgian, 8 lb. 11·67 oz., and Flemish × Tan, 7 lb. 3·00 oz.); Beveren, 7 lb. 0·47 oz.; Dutch, 4 lb. 14·00 oz. It will be seen that popular varieties of fur and fancy breeds bred more freely than giants. Furthermore, after weaning, the small types were ready for further breeding sooner, and more readily, than large heavy animals.

CONCLUSION

The Flemish Giant is the largest breed of rabbit, but it is slothful and more difficult to breed than either the medium-sized fur breeds or the small fancy breeds (for example, Beverens and Dutch), when fed and managed under similar conditions.

First crosses from Flemish were fertile, irrespective of whether the cross was to large or to small breeds.

After an abnormally severe winter, which resulted in changes of diet, the average litter size of larger types was lower than expected and nearer the level for small breeds.

[1] Standard. Flemish Giant Rabbit Club, London.

[2] Wilson, W. King, and McCartney, W., "Rabbit Feeding for Meat and Fur", Imperial Bureau of Animal Nutrition, Aberdeen, Technical Communication No. 12 (1940).

[3] Pickard, J. N., "A Preliminary Study of Some of the Factors Influencing the Duration of Pregnancy and Litter Size in the Rabbit," IVth World's Poultry Congr. Papers, Section F, 901 (1931).

[4] Rosahn, P. D., Greene, H. S. N., and Hu, C. K., *Proc. Soc. Exp. Biol. and Med.*, **31**, 1214 (1934).

[5] Punnett, R. C., and Bailey, P. G., *J. Genet.*, **8**, 1 (1918).

[6] Pease, M. S., *J. Genet.*, **20**, 261 (1928).

[7] Castle, W. E., "Size Inheritance in Rabbit Crosses", Carnegie Inst., Washington, Pub. No. 320, 3 (1922).

[8] Wilson, W. King, *J. Heredity*, **27**, 127 (1936).

[9] Wilson, W. King, "Alternative Modes of Inheritance of Steel Grey Coat Colour in Rabbits", VIIth Internat. Genet. Congr., Section D, 1939.

[10] Punnett, R. C., *J. Genet.*, **2**, 221 (1912).

[11] Punnett, R. C., *J. Genet.*, **5**, 37 (1915).

[12] Punnett, R. C., *J. Genet.*, **23**, 265 (1930).

[13] Pap, E., *Z. Induktiv. Abstammungs- und Verebungs-lehre*, **26**, 185 (see 14) (1921).

[14] Onslow, H., *J. Genet.*, **12**, 91 (1922).

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BICENTENARY OF HENRY CORT

OF the leading contributors to the advancement of British industries in the latter half of the eighteenth century, Henry Cort is the one of whom we know least. It is generally stated that he was born near Lancaster in 1740, and to mark his bicentenary, at a meeting of the Newcomen Society on November 13, Dr. H. W. Dickinson read a paper giving much new information about the inventor and his activities. Though nothing is known of Cort's education and early life, by 1765 he had established himself in London as a Navy agent, having an address in Crutched Friars in the east of the City, in which also was a Navy pay office. The district was one familiar to Pepys and has many associations with the Navy of bygone days. A Navy agent was a banker and attorney who acted for H.M. ships as to pay, allowances, prize money, salvage and such like; and it was Cort's connexion with the Navy which ultimately led to his becoming an iron master.

From 1765 Cort slowly emerges from the obscurity of his early life. In 1768 he married a niece of a Mr. Attwick who had contracted to supply mooring chains and other iron naval stores to Portsmouth Dockyard, but who in 1772 assigned his contract to a Mr. Morgan, who had a forge at Fontley, in the parish of Titchfield, two miles from Fareham at the north-west corner of Portsmouth Harbour. Britain at this time was largely dependent on Sweden for its wrought iron, and Morgan's work consisted more in remaking old wrought iron into new articles than in the production of the iron itself. From the beginning of the eighteenth century a forge had been in existence at Fontley, where there was a tilt hammer worked by water-power and an adequate supply of charcoal. Morgan being in financial difficulties, Cort came to his assistance, and in 1775 took over the management of the concern. Under Cort, the works were improved and the profits considerable. In spite of this there was further need for capital, and Cort accordingly secured the help of Adam Jellicoe who, while pay clerk at Portsmouth, had acted as his agent.

By 1781–83 the works were engaged on the conversion of considerable quantities of old iron mast-hoops into new hoops, and it was then that Cort made a variety of experiments and took out the first of his two memorable patents. The date of this patent, No. 1351, was January 17, 1783. It was for "A New Mode and Art of Shingling, Welding and Manufacturing Iron and Steel into Bars, Plates, Rods and otherwise, of Pure Quality, in large Quantities by a more effectual Application of Fire and Machinery, and with greater Yield, than any Method before attained or put in practice." "In the specification Cort further described passing the heated iron through

the rollers of a common rolling mill and the making of bars, bolts, half flats, etc., by the use of rollers with grooves and collars."

Thirteen months later Cort secured his other patent, No. 1420, of February 13, 1784, for "A Peculiar Method and Process of Preparing, Welding, and Working various Sorts of Iron, and of reducing the Same into Uses by Machinery," in which he described the process afterwards known as "dry puddling", a process which, using coal instead of charcoal, was destined to be of immense importance to the iron industry. In examining Cort's practices and patents, Dr. Dickinson came to the conclusion that there could be no doubt that the patents are simply a recapitulation of the technique Cort was carrying out at Fontley. Cort, of course, was not alone in his endeavours to improve the production and working of iron, but after reviewing the efforts of his contemporaries Dr. Dickinson concluded that "what we can say of Cort was that he gathered existing knowledge and technique, absorbing what was useful and necessary for his purpose, rejecting what was not needed, and combining it into a system which, as a whole, constituted such an advance that it marked an entirely new era in the manufacture of wrought iron. The effect of his labours was immediate; whereas a tilt hammer had been able to produce a ton of bars in 12 hours, no less than 15 tons could be passed through the rolls in the same time; the iron, produced as it was entirely by pit coal, was of a quality that enabled it to compete for all but the most exacting requirements with the charcoal iron of Sweden, Russia and New England. The process enabled Great Britain, relying on mineral fuel, to advance within a decade to the premier iron-producing country of the world."

Contracts from the Navy Board continued to come to Cort and Jellicoe, and Cort travelled to many places to assist iron makers to instal his rolls and puddling furnaces. If all had gone right he should have gained a fortune comparable to that later enjoyed by Bessemer. It has been the lot of many inventors to see the financial rewards due to them slip through their fingers, but none of them, perhaps, was treated more unkindly by fate than Cort. Five years after his patent of 1784, which afterwards led to the construction of puddling furnaces by the thousand, Adam Jellicoe died and his papers showed that he was in default to the Navy for no less than £39,676. There being then no limited liability, the works were seized, no effort was made to exploit the patents, and Cort was reduced to bankruptcy. With a numerous family Cort was left to struggle along as best he could, save that in 1791 he was granted a Government pension of £200 a year, which with reductions for fees amounted to little more than £160. Nine years later, on May 23, 1800, he died and was buried in Hampstead Churchyard, his death passing with no notice save a couple of lines in the *Gentleman's Magazine*.

Such is briefly the outline of the story Dr. Dickinson had to tell. Many famous men were interested in Cort's work, including Black, James Hutton and Watt, and the latter wrote of Cort as he knew him at the age of forty-four that "he seems a simple good-natured man, but not very knowing." Though neglected in his day, Cort has not wanted for admirers in our own times, and it was through an American ironmaster, Charles H. Morgan (1831–1911), that Cort's tombstone in Hampstead Churchyard was renovated and a bronze tablet placed in the porch of the church saying that to Cort "the world is indebted for the arts of refining iron by puddling with mineral coal and of rolling metals in grooved rolls". Introduced in a period when the steam engine was making rapid strides, when men were experimenting with iron boats, steam-boats, locomotives, and iron railroads, and when iron was being widely used as a material for construction, Cort's improvements enabled our ironmasters to meet all the rapidly growing needs of the pioneers of the modern engineering world, and his methods were not superseded until the labours of Bessemer, Siemens, Martin and others ushered in the age of steel.

SOIL BACTERIA AND WAR WOUNDS

By Dr. Hugh Nicol

A SURGICAL development which evolved on a large scale in the recent Spanish Civil War is the treatment of dirty and often comminuted and complicated fractures by immobilization in a plaster cast. The cast is applied immediately after the wound has been made 'mechanically' clean by removal of bone and metal splinters and fragments of clothing and other foreign matter and by resection of all dead tissue that can be found; no antiseptic is applied to the wound itself. Subject to this preliminary cleansing and to the provision of traction and drainage as necessary, no other treatment is given during the month or so during which the first cast is in position; the plaster is then changed, and the second cast is allowed to remain for some weeks, after which union and healing are usually remarkably complete.

The success of the treatment depends on ignoring the bacterial processes such as surgeons normally take great pains to combat by the use of antiseptics, irrigation, and frequent changes of dressings: it has been found that, given the initial surgical *débridemen* and cleansing, and complete immobilization, no general infection occurs. There is locally great microbiological activity, as is evidenced by the stench given off during the first three weeks (this is apparently the only objectionable feature of the treatment), but undesirable complications of bacterial origin—such as gas gangrene—are rare. The treatment is largely empirical; its justification is that it has worked. A history of the treatment and an analysis of its application to a large number of cases have been given by J. Trueta[1], sometime director of the Department of Surgery in the General Hospital of Catalunya, Barcelona.

It could scarcely be expected that in the stress of civil war the microbiological changes could be examined in detail. It has been shown (*loc. cit.*) that the organisms in a plaster-treated wound are mainly aerobic, but no particular species or group of aerobes predominated, except that there was a tendency for

B. pyocyaneus to become more numerous when the healing process was well established.

However obscure the theory of the treatment is, the references to soil bacteriology made in connexion with it require attention. Trueta records (p. 17): "The incidence of gas gangrene and of other infections fell so markedly [after a thoroughgoing adoption of the treatment] that it has been suggested that the soil of Spain contains no anaerobes. These suggestions emanate from foreign surgeons who came to Catalonia in the later stages of the war: at the beginning it was demonstrated grimly enough that the soil of Spain is not free from these organisms." This notion is not confined to Spanish territory. The commandant of an English ambulance who is known to me attended in London a course of lectures given by a British medical man, who averred that the treatment could not be expected to be successful in all countries: in Spain, where such sub-tropical crops as grapes and oranges grow in the open air, the soil micro-organisms were necessarily different from those occurring in more temperate climates.

Though no determination of Spanish soil microflora is at hand, there is no evidence that the broad types of soil micro-organisms vary with climate. A high degree of constancy of species has been demonstrated for soil Protozoa in samples taken in the most diverse parts of the world[2], while to mention only three sets of determinations of species of soil bacteria, the work of Chr. Barthel[3] on Greenland soils, and various papers by M. Adachi [Adati] on Formosan microflora, have revealed scarcely any but familiar species; a similar remark applies to the bacteriological findings from the second Byrd Expedition to the Antarctic. Barthel also showed that the dung of polar mammals contained bacteria similar to those occurring in the dung of common animals of temperate regions.

The main groups of soil bacteria are probably ubiquitous, and the medical men concerned should call upon their soil scientist colleagues before erecting theories about the distribution of soil micro-organisms. One is left with an uneasy feeling that the fact of the existence of anaerobes in Spanish soil has been established by the clumsy method of observation of human patients. The point is not important, but co-operation between soil bacteriologists and the medical profession would have obviated a mis-statement.

The success of the treatment seems to repose less upon the distribution of bacterial species than upon a factor or set of factors to which the medical profession in its preoccupation with pathogenicity of bacteria has given little attention: namely, the powers of resistance of living tissue towards microbial invasion. R. Giani[4] showed that inoculation with anthrax bacilli of open wounds of experimental animals was harmless if the affected limb was immobilized. This is significant, and if the true implications of the plaster-cast treatment of war wounds are followed up, the present importance of using antiseptics and of other treatments aimed at annihilating bacteria will almost certainly give way to a recognition of the importance of constructive methods of building up bodily resistance to adventitious infections.

[1] Trueta, J., "Treatment of War Wounds and Fractures" (London: Hamish Hamilton, 1939).

[2] See Sandon, H., "The Composition and Distribution of the Protozoan Fauna of the Soil" (London and Edinburgh: Oliver and Boyd, 1927).

[3] *Særtryk Medd. om Grønland*, **64** (København, 1922).

[4] Giani R. *Giorn. R. Accad. Med. Torino*, **11**, 165 (1905).

FORTHCOMING EVENTS

Monday, December 2

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Prof. S. J. Davies: "Recent Developments in Internal Combustion Engines" (Cantor Lectures, 3).

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 3 p.m.—Dr. J. V. Harrison: "Coastal Makran".

Tuesday, December 3

Royal Institution (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. J. D. Bernal, F.R.S.: "The Physics of Air Raids".

Wednesday, December 4

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. D. E. E. Gibson: "Problems of Building Reconstruction".

Thursday, December 5

Royal College of Surgeons of England (at the Royal Society of Medicine, 1 Wimpole Street, London, W.1), at 2.30 p.m.—Mr. T. P. McMurray: "The Semilunar Cartilages" (Robert Jones Memorial Lecture).

Friday, December 6

Association of Applied Biologists (in the Congregational Hall, Victoria Road, Harpenden), at 12 noon.—Sir E. John Russell, F.R.S.: "The Function of Applied Biology in War Time".

APPOINTMENTS VACANT

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

General Secretary—The Hon. Secretary, International Federation of University Women, 38 St. Leonard's Terrace, London, S.W.3 (December 4).

Headmaster of the Maidenhead County Boys' School—The Education Secretary and Secretary to the Governors, Shire Hall, Reading (December 5).

Keeper of the Yorkshire Museum—The Honorary Secretary, Yorkshire Philosophical Society, The Yorkshire Museum, York (December 7).

Teacher to take charge of Electrical Engineering—The Principal, Technical College, Wolverton, Bucks (December 9).

Assistant Officer (Civil Engineer) in the Indian Railway Service of Engineers—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (quoting Appointment 1/10A) (December 14).

Master of Method and Lecturer in Geography (male) at the Edinburgh Training Centre—The Executive Officer, 140 Princes Street, Edinburgh 2 (December 14).

Warden of Ashburne Hall of Residence—The Registrar, The University, Manchester 13 (December 18).

Registrar of the University of Birmingham—The Secretary, University of Birmingham, Edmund Street, Birmingham (January 1).

Part-time Teachers in Strength of Materials, Machine Design and Hydraulics—The Principal, South-West Essex Technical College, Forest Road, Walthamstow, E.17.

Mathematical Tutor in the Secondary School of the Gordon Memorial College, Khartoum—The Controller, Sudan Government Office, Oxford Hotel, 261 Clifton Drive South, St. Annes-on-Sea, Lancs. (quoting 'Mathematical Tutor').

Assistant Physicist at the Bradford Regional Radium Centre—The Medical Officer of Health, Town Hall, Bradford.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Indian Forest Records (New Series). Entomology, Vol. 6, No. 3: Possibilities of Control of Lantana (*Lantana aculeata* Linn.) by Indigenous Insect Pests. By Dr. C. F. C. Beeson and Dr. N. C. Chatterjee. Pp. iii+41–84. (Delhi: Manager of Publications.) 1·4 rupees; 2*s*. [111

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 237: On Coccids found on Roots of Plants in Egypt. By Mahmoud Hosny. Pp. iii+21+3 plates. (Cairo: Government Press.) P.T.3. [411

OFFICIAL ANNOUNCEMENTS

BRADFORD TECHNICAL COLLEGE

HARLOW FELLOWSHIP

Applications are invited for a HARLOW FELLOWSHIP under the Harlow Memorial Trust. The Fellowship will be of the value of £250 per annum, will be tenable for two years, and may conditionally be extended. The Fellow will be required to undertake research at the Technical College, Bradford, in one of the branches of Pure or Applied Science.

Applications, giving full particulars of previous career, should be submitted to the Principal, Technical College, Bradford, not later than January 1, 1941. No special forms of application are required.

ROYAL HOLLOWAY COLLEGE

(UNIVERSITY OF LONDON)

Principal: MISS J. R. BACON, M.A., Cambridge.

The Lent Term commences on Saturday, January 11, 1941. The College prepares women students for the London Degrees in Arts and Science. Entrance Scholarships, from £40 to £80 a year, and several exhibitions of not more than £35, tenable for 3 years, will be offered for competition in February, 1941. The last date for the receipt of entry forms is December 14, 1940. For further particulars apply to the Secretary, Royal Holloway College, Englefield Green, Surrey.

UNIVERSITY OF BIRMINGHAM

APPOINTMENT OF REGISTRAR

The Council invites applications for this appointment.

Commencing stipend £1,000 per annum. The Council wishes to make an appointment from April 1 next.

It is desirable that the Registrar should be a graduate of a British University.

Experience in University administration is desirable but not essential.

Applications (45 copies), supported by not more than three testimonials and three references, should be forwarded to the undersigned not later than January 1, 1941.

Further particulars may be obtained from

C. G. BURTON,
Secretary.

Edmund Street,
Birmingham.
November 1940.

CITY OF BRADFORD

REGIONAL RADIUM CENTRE

Applications are invited for the post of Assistant Physicist. Commencing salary £250 per annum.

Candidates (male) should possess a degree in Physics. Applications, stating age, qualifications, nationality and previous experience, if any, and accompanied by copies of three recent testimonials, should be sent to the Medical Officer of Health, Town Hall, Bradford, as soon as possible.

N. L. FLEMING, Town Clerk.

Town Hall, Bradford.
November 19, 1940.

THE INSTITUTION OF CHEMICAL ENGINEERS

EXAMINATION, 1941

Application forms (returnable December 16, 1940) and particulars of the Associate-Membership Examination for 1941, together with the Memorandum on "The Training of a Chemical Engineer" may be obtained from the Hon. Registrar, Institution of Chemical Engineers, 56 Victoria Street, Westminster, London, S.W.1.

LINEN INDUSTRY RESEARCH ASSOCIATION

Applications are invited for a vacancy for a Senior Assistant Chemist. Salary on the scale £375—£600 with F.S.S.U. benefits. Initial salary according to qualifications and experience. Textile experience is desirable.

Applications giving full details of age, qualifications and experience, should be addressed to the Secretary, Linen Industry Research Association, The Research Institute, Lambeg, Co. Antrim, N. Ireland.

Genatosan, Ltd., require the services of a fully qualified medical investigator for work on the Pharmacological and clinical testing of new drugs. Research experience essential. A commencing salary of £900 per annum is offered, with superannuation. Modern laboratory facilities for animal and pharmacological research will be provided.—Applications to the Chief Chemist, Genatosan, Ltd., Loughborough, Leicestershire.

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