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# BACKGROUND TO NATIONAL PLANNING

THE need for reconstruction, using the word in its largest sense, is world wide. Nevertheless, it must be realized that in many ways, as Mr. Anthony Eden implied in his broadcast talk on January 4 dealing with his recent visit to the U.S.S.R., the internal affairs of any country are peculiar to that country. Schemes of reconstructions suitable for one country might therefore not be appropriate elsewhere. Here it is proposed to consider recent literature dealing with the subject in Great Britain.

The summary report recently issued of the Oxford Conference of the Town and Country Planning Association* held last spring emphasizes, if that were needed, that the value of the Conference would emerge over a period, rather than in tangible results registered during the week-end. The volume makes available for the first time a clear and comprehensive account of the six sessions and relates them to the main aim of the Conference, namely, to crystallize and carry a stage further the national planning policy outlined in the nine agreed points of the Report of the Royal Commission on the Distribution of the Industrial Population. In doing so it provides an admirable yardstick by which progress can be measured, and in this respect can well be compared with Gilbert and Elizabeth McAllister's "Town and Country Planning" (see NATURE, Sept. 27, p. 353).

The need for such a background in considering the approach to post-war reconstruction, as well as for something of a yardstick for assessing progress, tends to grow rather than diminish. Such a measuring rod is essential in maintaining a sense of perspective in the growing literature of pamphlets, many of which are wholly admirable, and of the reports and studies of special aspects of the subject which are now appearing. It is also invaluable in assessing the actual proposals which may be formulated by the Government in the Bill to implement some of the findings of the Uthwatt Committee, and by local or professional authorities or institutions. The background provided by volumes of the type of the report of the Town and Country Planning Association is essential for the development of the principles by which the new pattern must be constructed and individual contributions assessed.

One of the happiest efforts to provide such a background has been Mr. F. J. Osborn's "Overture to Planning" in the Rebuilding Britain Series†, in

* Replanning Britain : Being a Summarized Report of the Oxford Conference of the Town and Country Planning Association, Spring 1941. Edited by F. E. Towndrow. Pp. 173. (London : Faber and Faber, Ltd., 1941.) 7*s*. 6*d*. net.

† Overture to Planning. By F. J. Osborn. (Rebuilding Britain Series, No. 1.) Pp. 29. (London : Faber and Faber, Ltd., 1941.) 1*s*. net.

which he emphasizes the need for clarifying standards of planning before they can be applied by a central department, as well as the necessity for founding planning firmly in the permanent needs of humanity. Towns must be shaped to answer to the needs of the family and industry and of the social life which enfolds them. Accordingly, it is imperative that there should be a clear idea of the new social pattern in which reconstruction will take place and of the several planes of social organization—the individual, the family, the local community, the region, the nation, and the commonwealth or family of nations.

The broadsheet "The New Pattern" in which such ideas are developed is one of the many valuable contributions which Planning (P E P) has made to the problem of re-integration and to planning for reconstruction which really meets contemporary needs and in which the several parts form a harmonious whole. In a more limited sphere the same conception inspires a pamphlet "Britain Must Rebuild" in the Democratic Order Series by Mr. Frank Pick*, whose death will be a great loss to Great Britain. While nothing short of regional planning offers the opportunity for a stable settlement, even deeper than the need for new demographic survey is that for an understanding of the social unit upon which democracy is to be built. That unit must involve all classes and carry within it no class distinction. Mr. Pick believed in the need for a correct and natural conception of the social unit, without which the social structure cannot be secure, and he emphasized the distinction between town and country. There must be a radical break between town and country; neither can be fittingly or properly built up until the social unit is defined.

This stress on the place of agriculture in planning policy—the insistence that as a first step no land may on any account be taken out of agriculture, and no land suitable for agriculture may be used for any other purpose—is a reminder that the necessity for planning agriculture for food supply makes some concrete measure of reconstruction and planning in the relations of town and country essential. Without at least the negative approach of resolute prohibition, neither utility nor amenity will be served in country or in town.

It would be unfair to characterize Mr. Pick's pamphlet as negative, but it is full of warnings as to the dangers which attend a policy of neglect or drift. A definite change in the national attitude must at some moment be realized, and the introduction of the expected Reconstruction Bill may well be the moment. Beyond the details of compensation and betterment, the interests of the people must override the interests of the owners, and a sharp, firm line must be drawn and maintained; the needs of agriculture, amenities and recreation must be provided for before we turn to planning and the location of industry, as "Replanning Britain" abundantly makes plain.

In regard to industry, Mr. Pick insists on the concentration and not the dispersal of industry, taking the trading estate as the model. He advocates compact housing and a new approach to regulation which eliminates fixed by-laws but visits severe penalties on the builder who tries to slip through them. The basis of any plan for rebuilding Britain is transport, and here again Mr. Pick concentrates attention on the function and purpose which the road or street is to serve, and on designing it to that end, subservient to the plan or scheme for the region. He visualizes the railway station as a nuclear point and stresses the conception of the city as a social organism, the vital organs of which should be aptly placed and proportional to the work they have to do. The awkward problem of blending town and country is met by a device of wedges of park and wood tapering inward and of houses and buildings tapering outwards around the central core.

In the planning of cities and towns, site control, sentimental fondness for the old, and the lack of an architectural style are still the three major difficulties. In regard to the first, the recommendations of the Uthwatt Committee have already indicated the line of advance. The second difficulty is being shattered by enemy bombardment as well as by the general disturbance of civil life caused by evacuation, dispersal of industries and the like. The third difficulty is one primarily for the architect through his professional associations, though not for him alone. The clients as well as the architects need education and imaginative insight if we are to develop a living architecture which finds expression in appropriate cultural forms in all the new and old materials which now are to our hand.

Mr. Pick had very clear ideas on the danger inherent in functional building, on the importance of planning the countryside, including its buildings, as country, the treatment of farms and the necessity of clearing away the ruins of decayed industry as well as of avoiding either sectional settlement of building or the tyranny of the expert or bureaucrat. He gives us a vision of the possibilities once we have chosen a pattern and address ourselves resolutely to the co-operative task of achieving it; and his concluding suggestion regarding the classification and labelling of buildings according to their fitness and suitability, if not of architectural merit, might well supply a practical incentive at little cost to better planning and building.

* Britain Must Rebuild: a Pattern for Planning. By Frank Pick. (The Democratic Order, No. 17.) Pp. 64. (London: Kegan Paul and Co., Ltd., 1941.) 1s. net.

The work of educating public opinion and clarifying the issues is clearly proceeding apace, and on the whole it is probably true that in this, as in some other fields, such as production, opinion is ripe for much more drastic and resolute action than the Government has yet proposed. Moreover, not merely are the principles and background of planning being vigorously explored, but also much of the detailed investigation incidental to the framing or execution of any reconstruction plans is being actively pursued. Already three interim reports have appeared from the Reconstruction Committees of the Royal Institute of British Architects, and a recent report of the Association of Architects, Surveyors and Technical Assistants makes a further contribution in this field.

The first of the reports of the Royal Institute of British Architects deals with planning and amenities, and reiterates the arguments in favour of a national planning authority. For post-war operation, any plan must be mainly constructive rather than restrictive in character, and for this reason the present exemptions from planning are undesirable. As the recent P E P broadsheet on "Publicly Owned Land" indicates, although the Forestry Commissioners, the Duchy of Lancaster, and the Commissioners of Crown Lands are not subject to the existing planning Acts, in practice they consult or co-operate with local planning authorities. Nevertheless there is much to be said for bringing the Crown lands and all other State-owned lands within the purview of the planning Acts in the normal way.

The interim report of the Royal Institute of British Architects indicates the machinery essential for a national plan, and the matters with which experts responsible for the preparation of such a plan must be concerned. The national authority should include the Ordnance Survey, at present under the Ministry of Agriculture ; the value of a new map on a scale of about three inches to the mile for the purpose of a national plan, fully contoured, is stressed. The authority should include the present planning department of the Ministry of Health, but not the detailed work of housing, the trunk roads and new roads, at present dealt with by the Ministry of Transport, as well as railways, ports, canals and public utilities, essential agricultural reservations, national and regional open spaces, approval and reservation of aerodrome sites. It should be supported by regional offices to deal promptly with these matters on lines laid down by the central authority as well as by regional groupings of the local authorities, which will decide as to suitable local planning areas and any necessary financial adjustments.

This outline alone indicates how important a contribution the establishment now of a national planning authority might well make not merely to post-war reconstruction but also to the co-ordination of our war effort.

This is equally true of the proposals, in the second interim report, on war-time housing, and in the report issued by the Association of Architects, Surveyors and Technical Assistants. Both these reports emphasize the way in which present and post-war needs are related and the importance of greater co-ordination among the authorities responsible for war-time housing. The report of the Royal Institute of British Architects recommends that in new *war-time* housing the single-family *peace-time* standard house should be abandoned in favour of hostel dwellings providing minimum living and sleeping accommodation with communal facilities for feeding, heating, washing and relaxation. The choice between permanent and temporary types of building should be governed by long-term as well as by immediate considerations. Of the permanent types, two- or three-storied structures should be built with the maximum amount of standardization, and this accommodation should be designed so as to provide for conversion later to peace-time housing standards.

The same conception of new housing of a permanent nature designed to give a high degree of protection, standardized to ensure speed of erection and utilize unskilled labour and capable of being adapted later as family homes and post-war housing is found in the Association of Architects, Surveyors and Technical Assistants' report, "Why Wait for the Blitz ?". Much of this report is concerned with provision of rest centres and feeding-centres in and outside the towns, and with the administrative work required, including the establishment of regional councils representing local authorities, trades' councils and Government departments, with full powers to execute schemes and to organize pools of labour and materials on a regional basis. It also includes a description of the blast- and splinter-proof housing devised by Mr. O. N. Arup in the scheme prepared for Clydeside to illustrate how it can be converted to a peace-time housing design.

The advantage of designing new war-time buildings to serve post-war needs in this way is obvious, but it may be lost entirely unless such construction is planned in harmony with long-term national and not merely sectional needs. Similar considerations give urgency to the recommendations in the Royal Institute of British Architects' first report regarding the control of design and the immediate investigation of the possibilities in the distribution of hot water and heat on an area basis, the saving of waste and salvage of useful material, the utilization of spoil heaps, disposal of refuse matter on a

mechanical basis and the avoidance of atmospheric pollution. Moreover, as the Committee points out, investigations into many aspects of both urban and rural life, such as rates and rating, public and private roads and public ownership of land are essential as a preliminary to the legislation which is already recognized as inevitable.

Since the publication of the Uthwatt Report, the memorandum on compensation and betterment submitted to that Committee by a special committee of the Royal Institute of British Architects has been published in the *Journal* of the Institute. This suggests a method of dealing with this difficult problem which will at the same time be fair to owners and retain the essential of private initiative. Like all other proposals, it insists on a plan as the first essential, and that all land should be deemed to be covered by a planning resolution. For developed land suitable areas can be readily defined for special rating for special improvements, but for undeveloped land the theory of the acquisition of development rights is unacceptable, and if any form of nationalization is to be considered it must not be allowed to be the subject of long years of argument and negotiation.

The really significant feature in the present situation is indeed, as the P E P broadsheet points out, that the question of land ownership and management has been taken to a remarkable extent out of party politics and is being considered on its merits. It is at last possible to tackle the problems of agricultural and urban land on something of a rational basis and to outline the beginnings of a twentieth-century land policy for Great Britain as a whole. This much has been achieved as a result of the P E P report on the location of industry, the Barlow Commission report and the combined effect of submarine warfare, which brought home the folly of neglecting farm and forest land, and bombing, which has at last compelled Parliament to consider extricating the cities of Great Britain from the strait-jacket of an anachronistic system which should long since have been recast.

That the Government is alive to the relation of agriculture and the reconstruction of town and industry is shown by some of Lord Reith's utterances, as well as by Mr. Greenwood in his introduction to the McAllisters' book, or indeed by Mr. Hudson's recent statement in the House of Commons regarding speculation in agricultural land and the issue of a defence regulation to prevent such speculation. That regulation is designed to prevent fresh obstacles arising to the acquisition or scheduling of land for planning purposes, and at the same time to avoid disturbance to the campaign for increased home food production. The scanty reference to such matters in the King's speech at the opening of Parliament, however, may well indicate that it will require all the interest and force of intelligent public opinion to ensure that legislation is not unduly delayed, and that it gives full expression to the hopes which have already been aroused, and uses to the full the opportunities which the War has brought.

Moreover, the third and most recent report of the Royal Institute of British Architects' Reconstruction Committee, on structural building legislation, indicates further directions in which immediate legislation is required. Its first recommendation is the establishment of one national building code for the whole country, formulating, on a scientific basis, standards of stability, fire resistance, and methods, details and materials of construction. There should be in London one central office for general administration with local administration of the national building code. The final and most important recommendation is the setting up forthwith of a national building board as an independent authority responsible to Parliament without being incorporated in the machinery of a Government administration. This board, which might be developed from the Building Research Board and the British Standards Institution, would be responsible for developing a national building research organization, the direction and co-ordination of research on materials and methods of construction and the formulation of the national building code.

These are constructive proposals, though it may be open to doubt whether such a board should not be part of the central planning authority. In this matter of reconstruction and of replanning Britain, however, education, inquiry and action must proceed side by side. Public opinion has already been prepared for advances, and is becoming aware of the importance of land policy and its possibilities. Whether in the war years we are to lay the foundations of a constructive policy of planning town and country side by side, which will use those opportunities and enable us after the War to build a new and healthier Britain, the towns and countryside of which will serve the needs of the new social pattern and contribute to new standards of health and nutrition and living and economic security, depends on whether we bring now to that task the courage, vision and knowledge it requires. The report of the Oxford Conference of the Town and Country Planning Association is a substantial contribution to that task of education. Although it may bring to the scientific worker little in the way of new knowledge, it should at least stimulate him to take a larger share in the task of educating his fellow-citizens, a task which must proceed side by side with the numerous investigations already attempting to gather the detailed facts and knowledge upon which alone a national planning policy can be based.

## BRITISH BIRDS

The Handbook of British Birds
By H. F. Witherby (editor), Rev. F. C. R. Jourdain, Norman F. Ticehurst and Bernard W. Tucker. Vol. 5 (Terns to Game-Birds) (Additions and Corrections) (Systematic List and Indices). Pp. xii + 356 + 22 plates. (London : H. F. and G. Witherby, Ltd., 1941.) 25*s*. net ; complete in 5 vols., 105*s*. net.

THE final volume of the "Handbook of British Birds" has now made its appearance, and it is pleasant to see that the high standard attained by the preceding four volumes has, if possible, been exceeded in this latest book with its handsome binding, clear print, and excellent illustrations. The editors are to be congratulated on having succeeded, despite the great difficulties of the times, in completing a work on birds which is without a rival not only in Great Britain but also throughout the world.

Terns to game birds are described in the present volume under review, and there is also a carefully compiled list of additions and corrections to previous volumes.

The first bird in this volume—the black tern—is of unusual interest, since, up to the middle of last century and even later, it continued to nest in the Fens of England. It is still seen, each spring and early summer, frequenting its former haunts for a few days while on passage to Belgium and Holland, Denmark and the Balkan States.

The common tern at its summer haunts is a bird of two distinct habits : it may nest in large colonies on the coast, or may breed in pairs along the shingly stretches of the Dee, Spey and other Highland rivers. On the Dee I have seen it nesting beyond Ballater—that is, as the river flows, fifty miles from the sea. A point which I have noticed is that these single terns are much more timid at their nesting haunts than the colonies which nest on the coast, and will not fly down to their eggs so long as they believe a human observer to be in sight of them. One difference between common and Arctic tern is the colour of the bill. In the common tern it is orange-red with black tip : in the Arctic tern it is blood-red throughout, and has no black tip. The Arctic tern's alarm note is shorter and harsher than the corresponding call of the common tern, and when on the ground the Arctic tern is seen to be shorter-legged.

The sudden flights out to sea of common terns (p. 29) during the nesting season is discussed. These periodic flights, during which the clamour of the nesting colony is suddenly hushed and all the birds fly in complete silence out to sea a little way before swinging in again and returning, still in silence, arise from some cause not yet understood. G. and A. Marples in their "Sea-Terns" (pp. 169—172) attribute the flights to sudden fear, of obscure origin. Arctic terns also make these flights, and so do kittiwake colonies. My own impression is that these aerial excursions are due to a sub-conscious migratory impulse. Certainly the flights become more frequent as the nesting season advances and as the August day approaches when, leaving belated eggs and immature young of various sizes to perish, the colony as one bird rises into the air and sets out towards the south.

The black tern is easy to identify, but there are many bird students who are not sure of the differences between common and Arctic tern. The full and careful descriptions of these two species, and the means of distinguishing them, are therefore valuable. The same remark applies to the rare roseate tern.

In the auk section of the volume the authors have been at pains to work out the distribution (p. 156) of the ringed or bridled variety of the common guillemot. In the eastern Atlantic there is a general tendency of increase in the bridled variety northward, and to a less extent westward, with some exceptions. Thus in the Portuguese colonies of these birds bridling is not recorded, while in France the figure is as low as 0·1 per cent. In Heligoland and the Baltic the figure is mainly between 1 and 2 per cent, as in the southern British Isles. In Shetland colonies this figure is greatly increased, and a further increase is found in the Faeroes, where the bridled variety form 34 per cent of the colonies. On the Westmann Isles, off the south coast of Iceland, bridled guillemots form 52·7 per cent of the colonies, but off the north of Iceland, on Grimsey, the figure falls, curiously enough, to 8·7 per cent.

Of the great autumn migration of the common guillemot south-westward through the Minch something might be said, the birds passing daily in thousands throughout the month of October.

The black guillemot (p. 163) would appear to be more sedentary in habit than the common guillemot. To the 'food' of this species might be added small conger eels and small flat fish.

A considerable proportion of the volume is devoted to the gull tribe.

In the account of the distribution of the large Arctic-nesting glaucous gull (p. 109), I am reminded that I have seen this gull on the River Dee in Aberdeenshire when fishing in early February at the opening of the salmon season. At this time of the winter a considerable number of kelt salmon have died after spawning. These fish are lying on the river banks, or in shallow water, and great black-backed gulls habitually enter the river valley to feed on them. One day I saw, with the great black-backs, a large white gull which could have been no

other than a glaucous gull, with which species I had been familiar in Spitsbergen. I suspect that this gull, when dead salmon are numerous, ascends the lower reaches of Highland rivers more often than is supposed. In the account of the gulls the difference in plumage between the British lesser black-backed gull and the Scandinavian lesser black-backed gull is clearly described (p. 96). In the Scandinavian species the mantle is slate-black ; in the British species slate-grey. During the years I had my home at Aviemore I used each spring to watch a migration of lesser black-backs flying, day after day, sometimes in considerable flocks, sometimes singly, north-east down the Spey valley. This migration continued through April and well into May, and the birds were presumably crossing from the Atlantic seaboard towards the Moray Firth basin, before travelling over the North Sea to the coast of Scandinavia.

A slight amendment might be made (p. 81) in the elevation at which the common gull is found nesting in Scotland. For "over 1,500 feet in Scotland" might be substituted "up to 3,000 feet". There is a loch on the White Mounth where a colony of these gulls nests at a height of 2,800 feet, and an occasional pair nests on a small loch higher up the hill, on the 3,000 feet contour line. These common gulls feed their young largely on ptarmigan eggs, which they steal from the nest and carry in their bills to their loch. The discarded egg-shells may be seen in the shallow water. This high loch is usually hidden in snow and ice in April, and the gulls pay several visits to it before they are able to settle here.

In the very full and thorough account of the Scottish ptarmigan (pp. 228—233) it is stated that the cock ptarmigan stands on guard when the young are hatched. The observer who makes this statement has great experience, but my own observations (I have seen many scores of ptarmigan nests and young broods) is that the male bird disappears from the nesting site the day the young leave the nest—and they leave it if the weather be fine an hour or two after they are hatched. My wife and I have photographed ptarmigan broods a few hours old, and although the hen has shown intense anxiety, the cock has never appeared. I mention this, for it has always seemed to me that the habit of a most devoted mate in suddenly deserting the newly hatched young is strange and unusual.

Ptarmigan, like red grouse, cover up their eggs before the clutch is complete and the hen bird begins to brood, and sometimes a few white feathers adhering to this covering give away the nest.

Ptarmigan are found in various forms throughout the world, and when I was in Iceland recently with Mr. J. C. Harrison (who has an admirable plate of skuas in flight in the volume under review) I was interested to see that the Iceland ptarmigan frequents the glens and low country, where it may be seen from the road. We both remarked that the wing beats of the Iceland ptarmigan were much more rapid than those of the Scottish ptarmigan, and that the flight recalled that of a partridge rather than a ptarmigan.

No one interested in birds can afford to be without the fifth volume of this standard work.

SETON GORDON.

## THE MESSAGE OF THE GARDEN

### Green Enchantment

The Magic Spell of Gardens. By Rosetta E. Clarkson. Pp. xx+328. (New York : The Macmillan Company, 1940.) 12*s*. 6*d*. net.

REALLY good enchantresses have always had more than one string to their bow, though those who escape their snares would probably put it the other way about. When they were young, enchantresses could afford to rely entirely on their charms for the bewitching of man ; but as they began to grow old and their charms began to fade, they took to casting spells. For that they had to go to the fields and hedgerows and gather green plants in the moonlight for the raw material out of which all the best spells are made. If enchantresses werel ucky and escaped a watery grave, their increasing years turned them into witches. Bent double by bending over ditches and riding broomsticks, they could no longer go far afield to find the herbs that specialized in being magical. That did not stop the witches, however, for they could find all the magic herbs they needed in the garden. From being used so often for spells, the plants grew more potent, and presently the garden itself became still more the home of magic than it had been before—a place of green enchantment.

No one can go into the garden now—be it large or small, wild or formal, neat or unkempt, well or ill planned—without falling under its spell ; at all events they will not after they have been taken there by Rosetta E. Clarkson and have heard the stories she has to tell of garden green enchantment.

How wise she is to begin with a sort of exorcizing to restore its good name to the garden. She says nothing at first about the witches and the spells and charms. She starts off with the gentle monks and their horticultural acolytes, and shows them at work in the monastery garden : planting herbs for healing, odorous plants near the sick room windows to appease the suffering inmates, lilies and roses and flowers of

every kind in the sacristan's garden—these for the altar and for garlands in processions on holy days; they named it paradise. Even when urban popes and cardinals told them not to, the simple monks went on growing the flowers all the same. They made walled gardens for fruit trees and they made vineyards too. Is there not still a street corner called the Vineyard near the Abbey Gates at Abingdon? Nor did the monks forget the vegetable garden. They planted it not only for summer use but also for food in the long winter.

Then when the monasteries declined, it was the wicked barons who took to gardening. They filled in their moats and made gardens there. They had to do something because Henry VII would not let them fight any more, nor use their castles as strongholds in his defiance.

Throughout these centuries plants from all over the world came crusading to England, and having conquered it settled down in our gardens. What the castle grew the cottager would have, and many a plant which died on the squire lived on in the cottager's plot. Why! it may be that to-day, Madonna lilies flourishing in a sunny corner of the cottage garden have been growing there since Tudor times: still magical in their immortality.

When printing came, everybody began to write about plants, and the great days of the herbalist began. Books by the score, editions by the dozen, sometimes by the hundred, were written and printed and even read.

All these things and many more are to be learned from Rosetta Clarkson's story. She shows you the plants they grew. Tells the lovely names the common people called plants by—no one except the very great was afraid of being called sentimental then. You can see the tools that were used. You can wonder at the infinite variety of sallets in the old gardens now dwindled to the solitary lettuce in ours, the flowers that went to conserves and preserves to give plenty of vitamin P on winter's table.

It is only towards the end of her story that the author opens a little wicket gate creaking on its hinges and leads her enchanted companions into the witches' garden; lets you see the fumitory that wards off the evil eye, the rosemary for remembrance, the woodbine that has bewitched so many cattle, the elder that makes warts go away and the parsley with seeds that have to go nine times to the devil before they consent to germinate. Every witchery that ever was is still there, preserved for ever in the names the plants bear.

When she has finished and you awaken from the enchantment, there seems to come into the mind a new understanding of the ever green enchantment of gardens. There and there only may be got glimpses of the country—all the countries of the world—and of the forgotten ways of country life. There pleasure and utility go hand in hand, united, made one, so that for the moment life becomes a whole, as it never can be in cities. It beckons man back to Nature, and though urban folk ignore the invitation they feel the summons in their bones; recognizing, if only faintly, that the problem facing all societies is how to remain urban without losing the last traces of rusticity. While there is life—garden life—there is hope, hope that the unspoken warning of the garden may be heeded before it is too late.

F. KEEBLE.

## CHEMICAL ENGINEERING EXPERIMENTS

The Applications of Chemical Engineering
Edited by Prof. Harry McCormack, in association with E. W. Comings, J. C. Elgin, W. L. Faith, O. A. Hougen, Joseph H. Koffolt, Harry McCormack, R. A. Ragatz, J. H. Rushton, Henry T. Ward, J. C. Whitwell, James R. Withrow, Lincoln T. Work. Pp. x+431. (London: Chapman and Hall, Ltd., 1941.) 21*s*. net.

THE title of this work might indicate that it deals with the application of chemical engineering theories to the solution of industrial problems, but this is not the case. It is, actually, a comprehensive collection of experiments for the use of students. This, however, is an inadequate description; the volume represents the outcome of the labours of a succession of committees which since 1929 have been collecting and arranging material suitable for a practical course, and the result is a detailed description of some seventy-five experiments classified under eleven main headings. Each heading forms a chapter written by an expert and revised by the committee in order to obtain uniformity of treatment. In a typical chapter the first pages are given up to a concise outline of the fundamental theories involved and the rest is devoted to the experiments, numerous specific references and a general bibliography of the subject being included.

It may be said that there are two main ways of presenting a practical exercise to a student. According to the first, he is given a piece of apparatus complete with all accessories and an instruction sheet detailing the object of the experiment and the exact method of performing it. According to the second, the object is given, but it is left to the student to think out what measurements must be made and what are the

most suitable instruments to use. There is little doubt that the second method is of far more value for developing originality and self-reliance than the first, but unfortunately, it may require an excessive amount of time and more attention on the part of the instructor than can be given. A compromise depending on the ability and experience of the student is probably the best solution. His early experiments may be conducted according to instruction sheets to familiarize him with general experimental technique, but as he progresses, more and more details may be omitted, so that finally he becomes dependent on his own initiative. It has been found in Great Britain, more particularly with larger apparatus such as stills and evaporators, that instructions can be cut down to a mimimum provided that two or even three students are assigned to the same experiment so that they may make simultaneous measurements and also discuss problems which arise during their progress.

The experiments dealt with in the book, while in nature similar to those conducted in the larger chemical engineering laboratories in Great Britain, are described with a wealth of detail which makes possible the adoption of the first of the above methods should it be required. A drawing of suitable apparatus or plant is given and a list of measurements which can be made. This is followed by instructions for performing the experiment and a set of typical results, with complete calculations. Experimental details which might escape attention are emphasized and the underlying theoretical principles are referred to at frequent intervals.

With regard to individual chapters, the first, dealing with the measurement of temperature, is an admirable article on certain aspects of precision thermometry, including a few experiments reminiscent of the elementary physics laboratory, but it lacks reality, and its connexion with the practical requirements of chemical engineering is not always obvious. For example, a student reading the description of a platinum thermometer would have no idea of the size of wire with which it is wound, or its resistance. No reference is made to the errors due to thermocouple sheaths insufficiently immersed or to thermal conduction along thick pyrometer wires. Black-body errors are mentioned, but it is left to a later chapter to give an indication of their magnitude, while the measurement of the temperature of a gas is confined to a brief note on one type of thermocouple. In practice, electrical measurements are rarely made on simple slide-wire bridges, and students should learn how to operate special instruments from a study of the wiring diagrams ; the two examples given are not very clear. It is suggested that this chapter might be recast.

The following chapter dealing with the flow of fluids gives a number of useful assemblies of apparatus suitable for most requirements ; some of the diagrams are perhaps a little sketchy and there is less detail than is to be found in subsequent chapters, but the information given is adequate and a student who had conducted all the experiments would be well equipped for dealing with fluid flow measurements on industrial plant.

Some subjects lend themselves more readily than others to simple experimental investigation, and the flow of heat, a matter of outstanding importance to the chemical engineer and the subject of the next chapter, is fortunately one of the former. Professor McCormack's treatment is most lucid, and fundamental principles are repeatedly emphasized throughout the mass of experimental details. One point to which more attention might have been given, if only because it is frequently neglected by designers, is the great increase in liquid film coefficient obtained by the use of high liquid velocities. This chapter is perhaps the most outstanding in the book, but a similar high standard is maintained in the remaining eight, which are devoted to unit processes. If any of these can be specially commended they are those dealing with distillation, drying of solids and gas absorption. This is not so much for any special features but because they offer more scope for experimental treatment than the rest. Whether the equipment required belongs to the category "simple" as described in the preface, or not, is perhaps a matter of opinion, but there will certainly be general agreement that the practical side of chemical engineering cannot be studied without adequate plant. A second claim made in the preface is that every experiment can be accomplished in a single four-hour period. This may be correct, but the desirability of rushing through what is in some cases a fairly elaborate series of measurements following upon preliminary adjustments, is open to question.

For those who are contemplating the establishment of a chemical engineering laboratory the book will be found invaluable. The experiments described are so numerous and cover so wide a field that a judicious selection, modified to suit the available apparatus, should afford ample material for a useful course. Those who already possess a laboratory will find many suggestions, either for utilizing their existing equipment in novel ways, or for adding to it and thus extending the scope of their practical work. No text-book on these lines has been produced hitherto and the Society for the Promotion of Engineering Education is to be warmly congratulated for a very valuable contribution to chemical engineering.

H. E. WATSON.

# GEOLOGY AND GEOLOGISTS IN THE NATIONAL WAR EFFORT

By PROF. H. H. READ, F.R.S.

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THERE appears to be considerable divergence of opinion among professional geologists in Great Britain as to the extent to which they and their knowledge can be used in war. Some hold that hundreds of geologists could be employed in the civil defence and armed forces; others protest that saturation would be reached by the employment of a score or so. Whatever may be the truth of this matter, however, all are agreed that the utilization of geological knowledge in the war effort has up to now been singularly haphazard. It is, of course, possible that a considerable proportion of the cases of the successful use of such knowledge never becomes public, while certain scandalous examples of neglect of geological information achieve, on account of their news value, a disproportionate notoriety. Still, if there were but one case of such neglect, the geologist would be entitled to lift up his voice. When he is officially informed that a sum approaching half a million pounds has been wasted through this cause at one aerodrome site alone, he must be pardoned if he becomes speechless, and especially so since, though he may faintly hope that those officials responsible for this waste have been liquidated, he is secretly sure that they have been promoted to posts with still greater possibilities.

As Prof. P. G. H. Boswell has pointed out in his presidential address to the Geological Society, issued on September 30, the fundamental reason for this haphazard utilization of geological knowledge is the lack of awareness on the part of the general public of the content of the science. The ignorance is, of course, especially profound among the politicians and the higher Civil Servants, while among scientific men it is often deplorable—a result in their case arising from a devotion, inculcated in the schools and fostered by examination requirements, to the unholy trinity of mathematics, physics and chemistry. One would have expected, on the grounds of value for money alone, a fuller utilization of geological knowledge which, in predominant proportion, has been accumulated and is being correlated and curated through the use of public funds of one kind or another. There is, however, little to be gained by elaborating this jeremiad, and we can with greater profit turn to the contemplation of such uses as have been made of geology and geologists in the war effort.

Large-scale industry, the sustainer of modern mechanical warfare, is founded upon iron ore and the solid and liquid natural fuels. Vital for the full development of its power, however, is a great variety of strategic mineral products, such as the alloy metals, the important non-ferrous metals, and a group of non-metallic minerals chiefly of a refractory or abrasive character. Further, food is a munition of war, and in consequence the mineral fertilizers are of strategic importance too. This fundamental dependence of industry upon mineral products becomes a lively topic during a time of mechanical warfare when it is impressed upon the political and Civil Service hierarchy that minerals are not evenly distributed among the nations, that supplies of vital raw materials are liable to interruption or even stoppage and that, in any event, minerals are bulky commodities usually requiring lengthy transport. A modern State, bent upon modern war, would naturally accumulate reserves of strategic minerals sufficient for the estimated duration of the conflict. We may be sure that the Axis has affected this obvious insurance, and that prophecies of an Axis shortage of oil, of some alloy metal or of some other strategic mineral product are liable to falsification.

An effort for autarky, or for the transformation of a peasant State into an industrial one, depends for success upon the discovery within the borders of the State of mineral resources of suitable size, character and variety. In this connexion, it may be recalled that thousands of geologists have been employed in mineral prospecting and development in the U.S.S.R. during the last twenty years. Their efforts have had remarkable successes; there have been notable and constant increases in Soviet mineral production, both in amount and variety. In NATURE of October 25, Prof. A. E. Fersman recorded that during the last quarter of a century, 75,000 new mineral fields were discovered in the U.S.S.R., that the known coal resources had been increased ten times, the resources of iron ore thirty-three times, and of lead and copper more than ten times. Fundamentally, therefore, the heroic Soviet resistance is possible because of the field-work of the Soviet geologists. It is my opinion that the most important use of British and American geologists in the war effort is to be found in the continuance of their jobs, often unheroic, of finding new mineral deposits and of developing maximum production of the required grades from these and the old fields. If the Allies hold on, it is comforting to reflect that the mineral resources of the British Empire, the U.S.S.R. and the United States are complementary to an extraordinary degree, while those of the Axis are thoroughly lopsided and, in the cases of the two junior partners, practically non-existent.

The interruption of supplies from overseas and the difficulties of transport have naturally led to renewed investigation, followed by development where possible, of native British mineral resources. In this work the dominant part is played by H.M. Geological Survey which, during its century of existence, has accumulated a vast store of information concerning mineral possibilities in Great Britain. The resources of coal and iron ore, the basic requirements of industry, have continued to be investigated in detail, while much attention has been directed to the discovery and workability of such ancillary metals and non-metallic minerals as this country can supply.

The results of a number of these investigations are given in the War-time Pamphlets issued by the Survey, which deal, in this connexion, with iron ores of various kinds, felspar, diatomite, dolomite and brucite-marble, silica-rock, phosphates, talc, chromite and limestones. This list, of course, by no means covers the complete field explored. It is gratifying to learn that production is taking place from mineral deposits discovered and investigated by the Survey. One success that may be mentioned is the find of a sand in Morvern, Scotland, suitable for optical glass and equal in quality to the best Continental sands, which is being worked on a considerable scale. In this type of investigation, the Survey is often helped by university and other geologists who have the advantage of detailed local knowledge. Such geologists, too, are being consulted on special problems of supply by Government and other bodies. In addition to investigations such as those mentioned, the

Survey deals with routine inquiries, some of which entail lengthy researches. A service of a similar nature dealing largely with inquiries from the Dominions, India and the Colonies is provided by the Mineral Resources Department of the Imperial Institute. This Department publishes monographs on economic minerals and valuable statistical reports on world mineral production.

The staff of the Geological Survey, however, is limited in number, its members rarely reside for long in any particular place, and they are unable, therefore, to record the innumerable temporary sections and exposures that are constantly being produced. The local geologist, whether university or lay, has opportunities of acquiring a detailed knowledge, especially of the superficial deposits, which is denied to his Government colleague. It is to the local geologist that the civil authorities, if necessary through the offices of the regional commissioner, should turn for geological information on such matters as the proper siting of shelters, supplies of sand, and questions of a kindred nature. So far as I am aware, this has been done in few cases; the results of this neglect can be seen all over the country. A similar absence of consultation between the military authorities and local geologists is indicated, for example, by the flooding of military works, the perilous position of certain tank blocks especially along rivers, and the instability of costly excavations. It is happier to record that in a few cases this desirable liaison has been established. Good work was done by some local geologists in indicating sources of sand for sandbag-filling in the early days of the War. Moreover, hundreds of thousands of pounds were saved in transport costs in London alone by following advice on the location of sand deposits given by the Geological Survey.

A very important war-time activity of the Geological Survey is connected with water supply, and many of the War-time Pamphlets deal with supplies from underground sources for various parts of the country. Movements of population, the formation of great military camps and aerodromes, and the construction of immense factories all raise problems in water-supply. Time was when a camp site was decided upon and then a water-supply demanded, but I understand that this procedure has now been changed. It is obvious that an accurate assessment of the present supply from underground sources, of emergency and even long-range supplies, has to be made, and especially in the so-called invasion areas. Piped supplies are liable to interruption by enemy action, and so the storage of water for fire-fighting in vulnerable districts may give rise to geological inquiry.

At the beginning of these remarks, I recalled the case of the scandalous neglect of geological advice at an aerodrome site, and I repeat that as complete a knowledge as possible of the geological conditions, both as regards water supply and foundation factors, at sites projected for costly camps, aerodromes and factories, is an obvious precaution. The Geological Survey and non-Government geologists are engaged in a certain amount of preventive work along these lines.

Readers of the more popular Press may have seen very remarkable accounts of some of the underground factories, stores and the like which have been constructed. Before the expenditure of vast sums of money on these great mining and engineering works, with their attendant housing and transport schemes, it is clearly a matter of common-sense to study in detail the prime control, the nature of the rocks and their arrangement. Here, again, the geologist has been utilized. The roughness of the geological story of Great Britain has resulted in our possessing a great number of suitable rocks suitably arranged for this purpose. A similar foresight is necessary in the construction of deep air-raid shelters and, again, most of our large towns have a fortunate geological past. At this point, non-geologists should ponder as to why London has its Underground, and draw a little comfort in these hard times.

What has been said above deals largely with the use, or non-use, of geological knowledge, but it has also been suggested that the best use of the geologist is to let him carry on with his usual work. This suggestion has not always been followed, and often it is the geologist himself who decides on a change of occupation. In certain branches of the Forces, a geological training is an advantage. All geologists can read maps and most can make them, some are expert drillers and others are familiar with mining and excavation methods. Men who have earned their living for years by the interpretation of aerial photographs should be employed in similar work in the Services. I have heard of an ex-geologist airman who finds his way about above England by his geological knowledge. There is a niche somewhere in camouflage for a geologist who will prevent the breaking of all geological rules in one small scheme, just as in happier times Hollywood might be persuaded to hire a geologist who would make sure that a film alleged to be in a Jerusalem setting would be set in Jerusalem geology, and not in that of California.

Such are some of the ways, then, in which geological knowledge and geologists are and are not being used in the war effort. The full employment of both can follow only from an adequate realization by the directorate of the possibilities of service.

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# MECHANISMS OF VISION

By PROF. SELIG HECHT

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THE symposium on visual mechanisms held on September 24 during the Fiftieth Anniversary Celebrations of the University of Chicago brought together some of the diverse methods and points of view found in the study of vision. Of the eight papers, three were concerned with the structures, materials and energy relations of the eye itself; one considered vision merely as an indicator of the state of the nervous system under anoxia; while the other four explored the relations between sensory phenomena and the central nervous system.

The morning session began with a report by Prof. Selig Hecht on the minimum energy required for vision. New determinations made under the best physical and physiological conditions yield values between 2·2 and $5{\cdot}7 \times 10^{-10}$ ergs, which correspond to 58 and 148 quanta of blue-green light (510 mμ). This is at the cornea. After corrections for reflexion from the cornea, for scattering and absorption by the ocular media, and for transmission by the retina, the range of 58–148 quanta at the cornea becomes 5–14 quanta absorbed by the retina. Since the stimulated

retinal area contains five hundred sensitive elements, a 2-quantum absorption by any one element is unlikely. Therefore, in order for us to see, only one light quantum need be absorbed by each of 5–14 retinal rods.

Because this number of events is so small, it may be derived from an independent statistical study of the relation between the intensity of a light flash and the frequency with which it is seen. Such experiments yield values of 5–7 for the number of critical events involved in threshold vision. Biological variation does not alter these values essentially, and the agreement between directly determined values and those derived from statistical considerations may be considered significant.

The results bear on the nature of the fluctuations shown by an organism in its response to a stimulus. The assumption has generally been that the stimulus is constant and the organism variable. The present considerations, however, show that at the threshold it is the stimulus which is variable and that the nature of its variability determines the fluctuations encountered between response and stimulus.

The light-sensitive substance of the retinal rods is visual purple. Prof. Arlington C. Krause, of the University of Chicago, has prepared enough visual purple so that common chemical procedures may be used for its study. He reported that visual purple consists of 50–65 per cent protein and 35–50 per cent lipid. The protein, though not well characterized, is conjugated with a complex lipid of fairly large molecular weight. The lipid contains nitrogen, sulphur and phosphorus fatty acids, and an unsaturated chromophore group, which may be carotenoid but is probably neither vitamin A nor carotene.

Several new substances can be isolated from the retina. Provisual red absorbs light between 340 and 416 mμ, gives an antimony trichloride reaction, and on hydrolysis yields fatty acids and visual red. Visual red absorbs only in the violet and ultra-violet, and also gives an antimony trichloride reaction. The yellow colour of bleached visual purple is due to visual yellow and indicator yellow. Visual yellow contains no nitrogen, phosphorus, or sulphur, and is insoluble in water. Indicator yellow contains both nitrogen and phosphorus, and is water-soluble.

Prof. Krause emphasized the similarities in light sensitivity and structure shown by visual purple and by cyanine dyes used for sensitizing photographic emulsions.

One of the outstanding characteristics of the central nervous system is its high metabolism and its great sensitivity to the lowering of the oxygen tension of the blood. Since visual impulses ultimately register in the central nervous system, visual function should be disturbed under anoxia. Prof. Ernst Gellhorn, of the University of Illinois, reported just such changes in brightness discrimination, visual acuity, colour perception, visual fields and negative after-images, and emphasized the rapid reversal of the effects by inhalation of oxygen. Since all these effects have in common the sensitivity of the nervous system to anoxia, it is concluded that they are an expression of this common factor. (It should be recalled that the retina also has a high metabolism and is sensitive to oxygen; indeed the recent work of Craik shows that visual function may be disturbed by local anoxia at the eye.)

Prof. Gellhorn presented evidence to show that the central nervous system possesses a progressively increasing sensitivity to anoxia in proportion as one goes to higher levels. This is illustrated by the effect of anoxia on eye movements: those which are elicited reflexly are less affected by anoxia than those which are cortically determined.

The final morning paper was by Prof. Heinrich Klüver, of the University of Chicago, who summarized the difficult and beautiful experiments with Rhesus monkeys made before and after removal of the striate cortex. By use of the pull-in technique, it was possible to measure the visual capacities of such animals in considerable detail. The results show striking differences between operated animals in dim illumination and in bright illumination. Dark-adapted animals without any geniculo-striate system are still able to discriminate the brighter of two stimuli under a variety of modes of presentation of the two stimuli. The just recognizable brightness fraction $\triangle I/I$ lies between 0·23 and 0·29. The same differential fraction is obtained for area discrimination of equally bright surfaces, and for distances (squared) of otherwise equal fields. This indicates that it is the total luminous flux which is recognized, rather than its distribution in space. A difference in total amount of light is distinguished whether it is achieved by distance or by area or by brightness variation. Form perception is thus permanently lost.

All this is at low illumination and involves only the dim vision of the duplicity theory. Indeed the effectiveness of the spectrum bears this out, because it yields a luminosity function similar to the scotopic luminosity curve of the human eye. For higher illuminations involving light adaptation, the operated animals lose all trace of differential response.

In the normal monkey, recognition of differences in brightness or area or colour are not seriously affected by the way in which the stimuli are presented. It is as if these properties remain relatively constant despite marked changes in stimulus constellation, and thus provide the animal with a stable visual world. The removal of the geniculo-striate system seems to eliminate these constancies irretrievably.

The afternoon session was opened by Prof. Theodore J. Case, of the University of Chicago, with a paper on occipital alpha waves. Under normal conditions, these rhythmic brain potentials from the two sides are in phase and approximately equal. Occasionally persons appear in whom there exists a gross difference in size of the occipital waves from the two sides, whereas the frontal alpha waves are equal. Such individuals possess lesions in the occipital or temporal lobes, usually involving the optic radiations that pass through these structures, and therefore causing partial blindness (homonymous hemianopsia) on the side opposite the lesion.

Examination of more than a hundred persons with supratentorial lesions showed that whenever the optic radiations were involved, there was always a substantial difference between the occipital alpha waves on the two sides, so much so that a gross difference in occipital waves may be considered almost a diagnostic sign of occipital or temporal lobe lesions. Since an interruption anywhere in the geniculo-calcarine pathway interferes with the occipital alpha waves of that side, and at the same time destroys vision, it may well be that the alpha waves actually exist in the optical radiations as an intrinsic rhythm upon which impulses from the visual organ impinge to form patterns for the mediation of vision.

Following this paper, Dr. S. Howard Bartley, of Washington University, presented some correlations between vision and neurophysiology. First, he

compared the potential changes in the optic nerve on stimulation of the eye with the known corresponding sensory experience. A short, weak flash of light results in a simple optic nerve discharge without subsequent changes. In vision this is registered as a simple flash of light. With a longer or more intense flash, the optic nerve record is a series of fairly regular waves following the simple *on* response. Visual experience reports this as a brief period of just distinguishable flicker. With a still longer or a more intense flash, there appears a prominent secondary wave which replaces the train producing the flicker; it and the *on* response yield the paradoxical experience of seeing two flashes. The secondary wave drops out as intensity or duration is increased, and visual experience loses its duality.

When the cortical response is recorded, the results are not so clear, and frequently involve interpretation. The most interesting fact is that a strong repeated stimulus may force the cortex to set up a rhythm in tune with the stimulus.

The paper by Prof. Stephen Polyak, of the University of Chicago, was a brief summary of material since published as a volume, "The Retina", in the Anniversary Series of the Chicago University Press. The essential point is that the complex structure of the retina agrees with the complex nature of the visual process. There are at least thirteen different types of neurons in the retina arranged in three levels: the photoreceptors (rods and cones), the analysers and association neurons (bipolar cells, horizontal cells and probably amacrine cells), and the integrators (ganglion cells).

The relations among these elements are complex and stable, and are at least thirty-five in kind. Some indicate an analysis of impulses from the photoreceptors; others suggest 'final common path' functions; while still others may even be inhibitory. Besides the perception of light and of colours, the retinal structures lend themselves to an interpretation of the various aspects of space perception, in terms of the degree of individuality in the connexions of the three components.

The symposium was closed by Prof. K. S. Lashley, of Harvard University, who proposed a new theory of cerebral organization. Animals are capable of perceptual generalization. When trained to differentiate on the basis, say, of specific sizes, they carry this over to a variety of visual arrangements. An object retains its essential form though we view it from different fixation points. The problem is that while nerve impulses are transmitted over definite pathways, behaviour seems to be determined by masses of excitation within general fields of activity without regard to particular nerve cells.

The exact topographical projection of the retina on the striate area may not be primary, because the olfactory sense is also accurately projected, yet it does not correspond to olfactory space. It may be that the geometry of nervous integration is quite different from the geometry of the stimulus.

The surface of the cortex contains connexions which permit the passage of activity in all directions. From a single focus, excitation may spread over the whole cortex, and because of the refractory period this spread will be wave-like. From several foci, interference patterns will be formed extending over the whole cortical area. Thus a given retinal configuration can produce a characteristic pattern of standing waves on the cortex which then forms the basis for its recognition.

Motor responses also are generalized. A rat which has learned a maze can follow it with unpractised muscle groups; thus a rat with a cerebellum lesion will roll rather than crawl through the maze successfully. The essential equivalent of visual perception is thus translated into an essential equivalent of muscle function. This means a revision of current notions of sensory motor organization. There is demanded a much more diffuse and widespread connexion between sense organ and motor neurons, a connexion in terms of an overall pattern perhaps such as is suggested for sensory organization.

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# RECONSTRUCTION IN CHINA

By ZING YANG KUO

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CHINA has already begun to plan her national reconstruction after the War. But given good plans for Chinese reconstruction, and given sufficient capital and raw materials, China may not be able to carry out her programme of reconstruction successfully and effectively unless she has adequate supply of scientific men, engineers and technicians. At present there is already great shortage of trained personnel in various fields, especially in science and technology. Due to the lack of library and laboratory facilities as a result of destruction by the Japanese, and also to the insufficient number of first-grade professors in China, the training of scientific and technical personnel for cultural and economic reconstruction in China will depend, more than ever before, upon sending students to study in American and British universities. Unfortunately, since the outbreak of the war in China, the number of students studying in the United States and Britain has been reduced by more than a half, while very few remain on the European Continent. Unless a well-planned programme for training men and women for the tasks of reconstruction is worked out well in advance, the shortage of scientific and technical personnel will be very much more acute when the War ends and reconstruction in industry and agriculture is begun.

Such a programme for training scientific and technical personnel for China calls for the active co-operation and assistance of Great Britain and the United States. It means that for many years to come, before the Chinese universities are re-equipped and brought up to modern standards, and have sufficient good teaching staff, Chinese students will continue to be sent by hundreds to the United States and Britain for scientific and technical education; it means that many American and British professors will have to be invited to teach in Chinese universities.

It was with this purpose in mind that I am visiting Great Britain and the United States as the representative on education of the Chinese Government to seek for co-operation and assistance from these two countries. As the project of inviting visiting professors to teach in Chinese universities cannot be carried out before the universities are sufficiently re-equipped, my negotiations in Great Britain have been confined to the arrangements for sending Chinese students to study in British universities or to obtain experience in factories. There are two parts in this project: (1) sending graduate students with two or three years of practical experience in China, either to study in a British university or to practise

in a British factory; and (2) sending a number of Chinese university teachers, especially teachers of science and technology, to Great Britain, to refresh their learning and to get acquainted with the latest developments in various scientific and technical fields.

British intellectual and industrial leaders have responded sympathetically and generously to my proposal in connexion with the first part of the project. If the arrangements so far made for sending Chinese students to be trained in Great Britain are carried out with success, I shall, in the near future, take up negotiations concerning the second part of the project.

American educational and industrial leaders have also responded to my proposal with sympathy and enthusiasm. It is hoped that through exchange of information and mutual understanding, the efforts of Great Britain and the United States to assist China to rebuild her culture and to train young minds for her national reconstruction can be co-ordinated, and that greater cultural co-operation between China and the English-speaking nations can be secured.

I have laid great stress on the importance for the national reconstruction of China after the War of training scientific and technical personnel. This must not be taken, however, to mean that other aspects of cultural studies, such as fine arts, philosophy, literature and the humanities, etc., are to be neglected. On the contrary, such subjects will receive due attention in the programme of cultural reconstruction in China. In fact, it is my hope that even in training young scientific workers and engineers each student would acquire a good cultural background together with his technical education.

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# OBITUARIES

## Viscount D'Abernon, P.C., G.C.B., G.C.M.G., F.R.S.

EVEN in peace-time, there is a constant but subdued lamentation on the part of scientific men that their subject receives but scant consideration by politicians and others controlling public affairs in formulating and executing public policy. In war-time such lamentation is less subdued. When, therefore, a great public figure has used the weapon offered by science to the great benefit of the State, it is only right that his death should call for more than a passing reference. Viscount d'Abernon, whose death at the age of eighty-four occurred on November 1, was a man who, without any special training in science, came to have a great belief in the part it might play in government. He was a man of remarkably wide interests and achievements, a statesman but not a politician, and a man of the highest culture, who knew, or wished to know, the best that had been thought and said in the world. He had also the keenest appreciation of art, especially of painting and the drama. Nothing human was foreign to him.

It will be remembered that, in the War of 1914–18, alcoholic intoxication became an enormous problem, of such magnitude indeed that it interfered greatly with the production of war material. To meet this situation, Mr. Lloyd George set up the Central Liquor Control Board and made Lord d'Abernon its chairman. The object was to find any or every means, short of prohibiting the production and sale of alcoholic liquor, which could reduce the evil to a minimum. The success obtained by this Board has never been really appreciated, but those who remember the extent of drunkenness in pre-war days cannot but conclude that the Liquor Control Board conferred one of the greatest social blessings on Great Britain. This inappreciation of valuable work is often seen when the state of man is changed for the better. Most medical men are very familiar with the phenomenon. They know only too well that, when a dramatic method of treatment is discovered, so that the dying or moribund are restored to health, this and its discoverer are hailed with great enthusiasm. They know equally well that, when a disease is eliminated by the discovery and application of a preventive method, there is no excitement, the change passes unnoticed and is taken for granted. This is what happened as the result of Lord d'Abernon's work in the case of alcoholic intoxication. The country has become relatively sober and the accursed social conditions due to widespread drunkenness have practically disappeared without comment.

Those with intimate knowledge of the Liquor Control Board know that Lord d'Abernon was not a figure-head as its chairman, but that he played the leading part in its deliberations and activities and gave up all his time to its work. The masterly way in which he controlled a body, which included brewers, clergy, politicians and Civil Servants, and obtained from them unanimous decisions, was a remarkable achievement. Confronted as he was at all stages by partisan statements on the action of alcohol, he decided that the only way of getting the truth was to appoint a body of scientific men in an advisory capacity. This body included among others Prof. (now Sir Charles) Sherrington, the late Prof. A. R. Cushny, Dr. (now Sir Henry) Dale, the late Prof. W. McDougall, and Prof. M. Greenwood. They gave careful consideration to the whole question of the pharmacology and toxicology of alcohol and proceeded to write the well-known book "Alcohol: its Action on the Human Organism". Where there were outstanding gaps of practical importance in knowledge, such as the relative intoxicating properties of concentrated and dilute alcoholic beverages, or the rate at which alcohol disappears from the body, or the kind of food which best inhibits or reduces the intoxicating effect of alcohol, he called for further experimental work. It fell to my lot to carry out this work on behalf of the Central Liquor Control Board. It was characteristic of Lord d'Abernon that he was not content simply to receive the results of this work, but often went to see the experiments on animals and man being made.

Had the Central Liquor Control Board been allowed to continue its work, d'Abernon's success in settling the liquor problem would have been even greater than it was. As soon, however, as Mr. Lloyd George saw that parliamentary agreement could be obtained on some of the Board's recommendations, he jumped in, secured the necessary legislation and dismissed the Board. Even so, its success was enormous, so that in a broadcast in 1931, Lord d'Abernon was able to say that "it had directly or indirectly added 100 millions to the public revenue and had cured the country of nearly two thirds of the evil results of intemperance". Brewers and distillers and public houses continued their lucrative trade, shareholders in these concerns drew the same or larger dividends. Patrons of Bacchus could still get their quota of

drinks, although more dilute than formerly, at more restricted hours and greater cost. Most of those directly interested in the trade were happy, and the rest of the country saw less home misery and fewer drunkards in the streets.

It is impossible in this place to write about other activities of Lord d'Abernon, but any one man who could be chairman of the Betting Control Board, of the Medical Research Council, the Industrial Health Research Board, the Lawn Tennis Association, the Thoroughbred Horse Breeders' Association, a trustee of the Tate and the National Galleries, clearly had many attributes of greatness. In the public eye, the most outstanding post held by Lord d'Abernon was his appointment in 1920 as the first British Ambassador to the German Republic, a position he held until 1926. Here again it is impossible to write of his work, but it is no secret that his ambassadorship was very successful and that in the eyes of those Germans who were in a position to know, he was regarded in Germany for several years as its uncrowned king. There was real friendship and trust between d'Abernon and Stresemann in those days, and the death of Stresemann at a crucial moment in international negotiations was always regarded by d'Abernon as one of the major calamities of Anglo-German relations.

After returning from Berlin, d'Abernon wrote a statistical report about conditions in Germany, which aroused great interest, and one result of this was his election to the presidency of the Royal Statistical Society. He was also made chairman of the Royal Commission on Museums and Galleries, and in this capacity rendered substantial services to science. In 1931 he was elected chairman of the Medical Research Council, but, shortly after his appointment, he unfortunately developed the first signs of the illness which incapacitated him, so that for the last five or six years of his life he was unable to participate in public life. It may be said, however, that during the early period of his chairmanship of the Medical Research Council, he broke all precedent by insisting on knowing personally individual workers of the Council, and on discussing with them their problems under investigation. Some of the friendships he formed with scientific men he retained to his death, and he never lost interest in their subject. His belief in the power of science to supply facts and knowledge necessary for the efficiency of the State was implicit, and towards the end of his life he wrote: "given persevering research and the proper use of available knowledge, we can confidently hope that within a generation every individual might be allowed to have the full development of health belonging to his inborn potentiality." Had we a few more men of affairs who, in addition to paying lip service to scientific methods and results, had the same belief in science and the prepared mind to make use of it, Great Britain would be a better place in which to live.

In 1934 Lord d'Abernon was elected to the fellowship of the Royal Society, a distinction he greatly prized.

EDWARD MELLANBY.

## Mr. T. E. Barr Smith

By the death of Tom Elder Barr Smith which was recently announced by cable, South Australia has lost one of the best of her citizens and the University of Adelaide a good counsellor and generous friend.

T. E. Barr Smith received his school education at St. Peter's College, Adelaide, whence he proceeded to Trinity Hall, Cambridge. He was the senior member of the firm of Elder Smith & Co., shipowners and wool merchants of Adelaide, with large pastoral interests in South Australia. Being intimately acquainted with both the production and marketing of wool, alive to the bearings of scientific research on the former and trusted by everyone, he played a useful part in the development of Australia's primary industry along sound lines.

Education and culture in South Australia owe much to the public spirit and generosity of members of the firm of Elder Smith & Co. When the University of Adelaide was founded in 1874, Sir Thomas Elder provided one half of the cash endowment, and Robert Barr Smith, Tom's father, endowed the library. Some twenty years later, Sir Thomas Elder presented a further handsome sum to found and endow a chair of music and a Conservatorium. Another partner, Peter Waite, left his fortune to endow a chair of agriculture and a research institute as part of the Department of Agriculture. The Waite Institute at Glen Osmond on the outskirts of the city is well equipped and provided for, and one of the most flourishing research institutes in the British Commonwealth. Yet another member of the firm of Elder Smith, Walter Young, served for many years as treasurer, and the University owes much to his wise guidance, particularly during the difficult years of the world economic crisis at the beginning of last decade, when the financial stability of Australia was shaken.

Tom Barr Smith's gifts to the University of Adelaide were generous and frequent. A vigorous young University must continuously expand its activities, and he contributed handsomely towards many of its developments. His largest single gift was a new home for the library. The Barr Smith Library is a fine separate building with ample provision for expansion. It is convenient, comfortable and comely. It serves as a noble monument to keep green the memory of one of the best friends of the University in the minds of future generations of alumni.

Tom Barr Smith was genuinely interested in science and learning, and found enjoyment in the companionship of those with similar tastes. Many scientific visitors to Australia will remember the charming hospitality extended to them by Mr. and Mrs. Barr Smith at their home at the foot of the Adelaide Hills, and their enjoyment of the company of this kindly, modest and shrewd Australian.

CHARLES MARTIN.

WE regret to announce the following deaths:

Prof. P. Flemming, emeritus professor of ophthalmic medicine and surgery in University College, London, known also for his work in archæology, on December 19.

Capt. T. A. Joyce, O.B.E., formerly deputy keeper in charge of the Sub-Department of Ethnography, British Museum, on January 3, aged sixty-three.

Prof. S. M. G. Ure, assistant professor of chemical engineering in the Imperial College of Science and Engineering, and reader in the University of London, on December 25.

Prof. T. Henry Wilson, formerly King's professor of midwifery in Trinity College, Dublin, and president of the Royal College of Physicians of Ireland during 1926–27, on November 20, aged seventy-eight.

## THE INSTITUTE of CHEMISTRY of GT. BRITAIN & IRELAND

(Founded 1877)

(Incorporated by Royal Charter, 1885)

### APPOINTMENTS REGISTER

A Register of Chemists (Fellows, Associates and Senior Registered Students), who are available for appointments or who are seeking to improve their position, is kept at the office of the Institute. The facilities afforded by this Register are available (free) to Companies and Firms requiring the services of chemists, and to Universities, Colleges and Technical Schools requiring Teachers of Chemistry and Technology. A list of Laboratory Assistants is also available.

Particulars of the Regulations and Examinations of the Institute can be obtained (free), on application to the Registrar.

All communications to be addressed to The Registrar, the Institute of Chemistry, 30 Russell Square, London, W.C.1.

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## WIGAN AND DISTRICT MINING AND TECHNICAL COLLEGE

The Governing Body invites applications for the post of HEAD OF THE PHYSICS DEPARTMENT, rendered vacant by the appointment of Dr. A. Harvey, B.Sc., Ph.D., F.Inst.P., to the Principalship of Scunthorpe Modern and Technical School. Duties will commence on April 1, 1942.

Candidates should possess (a) high academic qualifications, (b) industrial experience, and (c) teaching experience (preferably in a Technical College or University). Salary scale: £500-£20-£600.

Further particulars and application form will be sent by the undersigned on receipt of a stamped, addressed, foolscap envelope. Last date for the receipt of applications, January 17, 1942.

J. F. S. ROSS, M.C., B.Sc., Ph.D.,
Principal and Clerk to the
Governing Body.

December 22, 1941.

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## UNIVERSITY COLLEGE, CORK

**PROFESSORSHIP OF PHYSIOLOGY**

The Governing Body of University College, Cork, invites applications for the above full-time Professorship.

For further particulars apply to:

JOSEPH DOWNEY,
Secretary.

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## UNIVERSITY OF GLASGOW

**GARDINER CHAIR OF CHEMISTRY**

The University Court announce that the Gardiner Chair of Chemistry will be vacant on September 30, 1942, and that the Court will shortly consider the filling of the vacancy. It is the intention of the Court to appoint a Professor whose special interests are in Physical Chemistry.

Particulars as to duties and conditions of tenure may be had from the undersigned, to whom applications should be addressed on or before February 8.

ROBERT BROUGH,
Acting Secretary,
Glasgow University Court.

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## UNIVERSITY OF MANCHESTER

**EXTRA-MURAL DEPARTMENT**

**In co-operation with Tae Asso iation of Industrial Medical Officers**

Course of 9 Lectures: TOXIC HAZARDS IN THE CHEMICAL INDUSTRY. For Chemists, Managers, Doctors and others closely associated with the Industry. Saturdays at 2.30, beginning January 17, 1942. Fee for the Course: 10s. 6d. Further details may be obtained from the Director of Extra-Mural Studies, The University, Manchester, 13.

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One of the principal iron and steel producing companies desires to engage the services of a man between 30 and 40 years of age, who has had a sound scientific training, preferably at the Royal School of Mines, but not necessarily so, and who has subsequently had steel works experience, preferably in steel-making plant. Good salary. In applying please state full experience and references. All applications will be treated in the utmost confidence. Apply Box 819, T. G. Scott & Son, Ltd., Three Gables, London Read, Merstham, Surrey.

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Female Laboratory Assistant required for preparation of inorganic chemicals. Applicants should have reached Inter B.Sc. or similar standard.—Write, stating age, experience, etc., to Box 634, A. K. Advg., 4 Talbot Mans., Museum Street, W.C.1.

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Physicist required. Previous experience in connection with radiotherapy an advantage. Salary £450 per annum. Superannuation scheme in force. Applications, with details of experience and qualifications, should be sent to the Secretary, The Sheffield Radium Centre, at The Royal Infirmary, Sheffield.

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Physicist with first-class qualifications and several years of research experience in X-rays and physical-metallurgy seeks responsible position where his initiative and wide experience may be fully utilized in the war effort. Apply Box 818, T. G. Scott & Son, Ltd., Three Gables, London Road, Merstham, Surrey.

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Male or Female Assistant with a knowledge of photography, either professional or amateur, required for post in laboratory for graticule work in connection with vital munitions. Protected establishment. Excellent prospects for right kind of person. Write, stating qualifications, to Box 816, T. G. Scott & Son, Ltd., Three Gables, London Road, Merstham, Surrey.

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Botanist and Biologist, 15 years teaching, also research work, due to retire, seeks new post.—Box 817, T. G. Scott & Son, Ltd., Three Gables, London Road, Merstham, Surrey.

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Microscopes, second-hand, a large selection of instruments in perfect condition; 8d. stamp for list.—Chards, Specialists (Est. 70 years), Forest Hill, S.E.23.

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*THE fact that goods made of raw materials in short supply owing to war conditions are advertised in this publication should not be taken as an indication that they are necessarily available for export.*

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## MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM

**THE LABORATORY, PLYMOUTH**

Limited supplies of marine biological material are still available, but orders should be placed well in advance.

For prices and detailed information apply to:
THE DIRECTOR, THE MARINE BIOLOGICAL LABORATORY, PLYMOUTH.

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# NEWS and VIEWS

## The Washington International Pact

WHEN the history of the present times comes to be considered by a future generation, it is probable that the joint declaration signed at Washington on January 1, by the countries arrayed against one or more of the Axis powers, will mark a significant phase in the history of the world. By this document, no fewer than twenty-six nations have voluntarily subscribed to the fundamental principles of the Atlantic Charter signed by President Roosevelt and Mr. Winston Churchill last August. They have asserted their belief in the sanctity of human life, liberty and independence, and the preservation of human rights, justice and religious freedom in all lands. Further, the declaration is open to be adhered to by any other nations contributing to the struggle against the militarism, aggression and oppression represented by Nazism. By this momentous step, the freedom-loving nations have banded themselves together against a common enemy, and little imagination is required to see in it the beginning of the international collaboration which must follow the War if the world is not to be subjected to further upheavals with all the horrors of modern warfare. The free association of nations in the task of ridding the world of Nazi tyranny, and from the medieval suppression of learning and of freedom of thought which have characterized its progress through Europe, is a necessary preliminary to the building of that better 'order' towards which the thoughts of men are turned.

## New Year Honours

THE following names of scientific men and others associated with scientific work appeared in the list of New Year Honours :

*G.C.B.* : Sir Frank Smith, controller of telecommunications equipment, for services to the Ministry of Aircraft Production and to the Ministry of Supply.

*Knights* : F. C. Cook, chief engineer, Highways, Ministry of War Transport ; Col. J. R. Davidson, lately chief engineer, Metropolitan Water Board ; A. H. R. Fedder, chief engineer, Bristol Aeroplane Co., Ltd. ; H. M. Glover, chief conservator of forests, Punjab ; Prof. Bennett Melvill Jones, professor of aeronautical engineering, Cambridge, for services to aircraft development ; Dr. Cattamanchi R. Reddy, vice-chancellor of Andhra University ; Rao Bahadur Tiruvadi S. Venkataraman, sugar-cane expert, Coimbatore.

*C.B.* : Col. E. Gold, deputy director, Meteorological Office.

*C.M.G.* : Major G. St. J. O. Browne, labour adviser to the Secretary for the Colonies ; Prof. H. C. Sinderson, professor of medicine, Royal College of Medicine, Iraq ; A. J. Wakefield, inspector-general of agriculture for the West Indies.

*C.I.E.* : Sri Krishna, Forest Research Institute, Dehra Dun ; J. C. McDougall, Indian Agricultural Service, Central Provinces and Berar ; J. W. Nicholson, conservator of forests, Orissa.

*C.B.E.* : Dr. G. C. Anderson, secretary, British Medical Association ; J. M. Crofts, lately secretary, Northern Universities Joint Matriculation Board ; Miss M. Curtis, principal assistant secretary, War Damage Commission, principal designate of Newnham College, Cambridge ; A. C. Inskip, adviser to the Government of India on tanning and leather industries ; W. A. Macpherson Walker, adviser to the Government of India on jute supplies ; F. J. Martin, director of agriculture, Sierra Leone ; E. C. Ramsbottom, director of statistics, Ministry of Labour and National Service ; A. P. Rowe, superintendent, Telecommunication Experimental Establishment, Ministry of Aircraft Production ; Prof. S. P. Smith, professor of electrical engineering, Royal Technical College, Glasgow ; A. Wilson, a director of Imperial Chemical Industries (Explosives) Ltd., for services to the Ministry of Supply ; J. F. Wolfenden, lately director of pre-entry training, Air Ministry, headmaster of Uppingham.

*O.B.E.* : W. Abbott, staff inspector of engineering, Board of Education ; N. Barraclough, deputy chief inspector of mines, India ; W. R. Benzies, superintendent of natives, Bulawayo ; P. H. Carpenter, director, Scientific Department, India Tea Association, Tocklai, Assam ; E. L. P. Foster, chief forest officer, Andamans ; J. H. N. Hobday, chief veterinary officer, Bechuanaland ; G. Mayne Hopkins, divisional forest officer, United Provinces, India ; P. I. Kitchin, principal of Rugby College of Technology and Arts ; G. H. McKenzie, assistant production manager, Imperial Chemical Industries (Explosives) Ltd. ; H. E. Page, superintendent, Cordite Factory, Aravankadu ; P. E. Pollard, principal scientific officer, Air Defence Research and Development Establishment, Ministry of Supply ; N. S. Stevenson, conservator of forests, British Honduras ; J. Thompson, chief inspector of fisheries ; Dr. A. B. Wood, superintending scientist, Mine Design Department, Admiralty.

*M.B.E.* : P. W. Augier, divisional forest officer, Bihar ; J. McC. Black, a prominent botanist in South Australia ; W. E. Butler, factory works manager, Imperial Chemical Industries (Explosives), Ltd. ; J. A. Crosbie, mechanical engineer, Sind ; A. V. Gibberd, agricultural officer, Nigeria ; M. J. McDonald, divisional forest officer, Gorakhpur, United Provinces ; N. P. Mohan, deputy conservator of forests, Punjab ; Miss C. Murray, lately superintendent of domestic science, Glasgow Education Authority ; N. R. Reid, veterinary officer, Tanganyika ; B. N. Sarkar, deputy director of agriculture, Bihar ; J. T. Stapleton, technical officer, Directorate of Technical Production, Ministry of Aircraft Production ; G. V. Trivedi, divisional forest officer, Balaghat, Central Provinces, India ; Major O. H. Wansbrough-Jones, R.E.

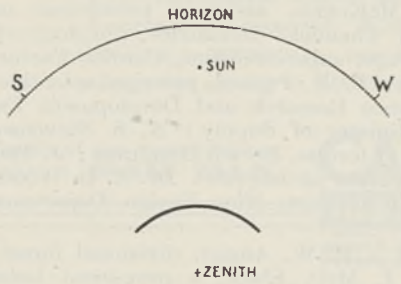
## University of Sheffield

THE thirty-sixth annual report of the Senate to the Court of Governors of the University of Sheffield for the year ending July 31, 1941, shows that the University had an active year in which academic and national interests had to be nicely balanced. During the year, the Departments of Zoology, Botany and Geography moved into the extensions at Western Banks in preparation for the 1941–42 session, thus releasing much-needed accommodation for the medical sciences and mathematics, and for the library. Fortunately, although no University building escaped damage during heavy air raids, there was little interference with work. The number of full-time students, which was 767 in 1938–39, fell to 667, but it is stated that the figures for the current session show no further decline ; only about a quarter of the students submitted themselves for voluntary medical examination at the beginning of the session. The Department of Engineering was engaged for

some time with day and night training of semi-skilled mechanics for armament factories, thus anticipating the Ministry of Labour scheme, and has since turned to the production of munition components. Many members of the staffs of the Departments of the Faculties of Pure Science, Medicine, Engineering and Metallurgy, have carried on research work in connexion with the war effort in addition to their normal duties. The Regional Committee for Education in H.M. Forces, centred in and worked from the University, arranged 702 lectures and talks.

## A Brilliant Atmospheric Arc

OPTICAL phenomena appear to have been very prominent in the upper atmosphere over the south-east of England on November 9, 1941. An account of a brilliantly coloured arc has been received from Mr. A. F. Dufton, of the King's Lodge, Hunton Bridge, Herts. Although the colouring is described as fully as brilliant as that of a rainbow, the colours being in the usual sequence with the red outermost,




the accompanying sketch, which was sent by Mr. Dufton, shows that the arc was not part of an ordinary rainbow, being parallel with the horizon. The radius of curvature was estimated to subtend about 40°, the sun being estimated to be about 50° from the nearest point of the arc (the middle of the arc). The phenomenon was seen at 4 p.m. B.S.T., and a trace of cirrus cloud was present. On the same day, Mr. L. C. H. Cave, of the Old Rectory, Blechingley, Surrey, as reported in *The Times* of November 24, that he saw a mock sun at Hitchin of exceptional brilliance, also at 4 p.m. B.S.T. This is described as being so bright that it was almost difficult to look directly at it.

## West African Forestry during 1940

IT may be asked whether the constant reiteration of the forest policy envisaged for the several Colonies under the Colonial Office produces the results obviously aimed at by the writers of annual forestry reports. The administrative authorities pass these reports and doubtless think that these statements read well and do not commit them to anything; and results in the past have shown this to be true. A forest policy put up by the forestry adviser may be accepted in whole or in part, but ruthlessly countermanded in a few months time for reasons having no connexion with a true appreciation of the value of the forests in the interests of the community. The heads of all three forest services in West Africa, Nigeria, the Gold Coast and Sierra Leone comment in their annual reports on the absence of military duties of a high percentage of their gazetted officers. The Conservator in Sierra Leone has four assistants; yet between them they only put in 18 months work in the department during the year (1940). At the end of the same year twelve officers, about half the Gold Coast forest staff, were on military service; while in Nigeria more than one third of the gazetted staff were on military service or other war-time duties. Yet in each Colony war-time demands are accelerating the exploitation of the forests. It is not therefore surprising that much of the work of a trained forest officer in the introduction of a proper management, such as reservation, including stock mapping preceding exploitation, in sylvicultural work with the object of the perpetuation of the forest estate, and other professional development work, was almost in abeyance during the year in all three Colonies.

It is difficult to regard this position with satisfaction in view of the recent debates in both Houses of Parliament on Colonial matters. For in each the inference was that the Colonial Office is not awaiting the end of the War, but is even now busy considering how the administrative machinery may be best speeded up and shaped so as to enable better conditions of livelihood to be enjoyed by the populations in the future. Where the improvement of agricultural practices is in question, or even education, the results —mistakes or otherwise—may become apparent within a few years. This is not the case with forestry. The postponement and procrastination displayed in the acceptance and adoption of a correct forest policy is almost a commonplace when applied to many of the Colonies; as is a recognition that forests cannot remain in a balancing or stable condition. They are either constantly improving or degrading. The most serious result of the absence of so many officers from the forest departments is the further delay in speeding up the placing of forest areas into the category of reserves when they come under the direct management and care of the forest officer.

## Public Health in the United States

ACCORDING to provisional data for 1939 compiled by the Public Health Service of the United States the general mortality in 45 States, the Districts of Columbia, Hawaii and Alaska, was 10·7 per 1,000 inhabitants, as compared with 10·6 in 1938. Infantile mortality was 48 per 1,000 living births, the lowest hitherto recorded. The fall in maternal mortality continued, being 10 per cent lower than in 1938 (4 per cent live births). During the year 1939 no case of cholera or yellow fever was reported, but one case of plague was notified in the State of Utah. There were 403,037 cases of measles, or less than half the number in 1938, and 9,877 cases of smallpox as compared with 14,938 in the previous year. At the beginning of the summer of 1939 there was an outbreak of poliomyelitis in the States of the Atlantic coast with a total of 7,339 cases compared with 1,705 in 1938. The incidence of diphtheria, cerebrospinal fever, scarlet fever, typhoid and paratyphoid fevers was much less than the average for the quinquennium 1934–38. There was an outbreak of influenza in February 1939 which subsided towards the middle of July, but there was another outbreak in October which lasted until June 1940; in 1939 there were 275,503 cases notified, or more than double those in 1938 and 40 per cent above the average for the quinquennium 1934–38. 2,996 cases of typhoid fever were notified in 1939 as compared with 2,294 in 1938. The mortality from typhoid, paratyphoid, measles, scarlet fever, diphtheria, encephalitis, meningitis, tuberculosis, malaria, pellagra, affections of the

alimentary tract, syphilis, diarrhœa and enteritis in children under two years, and accidents (including motor accidents) were the lowest reported in the last five years. The mortality from pneumonia was very low in 1939, the diminution being more than 33 per cent compared with 1938. The increases in the mortality from cancer, diabetes, cerebral hæmorrhage and heart disease must be attributed principally to the greater age of the population.

## Nature of the Long-period Variable Stars

R. M. SCOTT has an article on the long-period variable stars in the *Telescope* of September–October, which provides a popular description of the type of star of which Mira is a prototype. The spectra of these stars reveal that they are cold enough to contain molecules, and yet sufficiently hot to show the bright lines of hydrogen and ionized metals, and a brief explanation of the probable reason for this follows. Assuming that these stars are pulsating, we can picture a small core about the size of our sun surrounded by an atmosphere extending to a distance comparable with that of the earth from the sun. Viewed from a distance, one of these stars would present the appearance of a luminous fuzzy ball, deep in a hazy murk, and it is easy to imagine flames similar to solar prominences hovering deep in the smoky atmosphere near the luminous core. Then as the star approaches minimum the atmosphere would become darker and more clouded and the core a deeper red, the eruptions practically disappearing. It is possible that these red variables may be a link in the evolutionary chain, great numbers of stars starting their lives as red variables and then outgrowing their adolescent pulsations. On the other hand, red-variable pulsations may represent the palsy of stellar old age, though the former theory is the more popular of the two. At present this type of star presents a problem which can only be solved by much more investigation.

## William James (1842–1910)

WILLIAM JAMES, the well-known psychologist and philosopher, was born in New York on January 11, 1842, the son of the Swedenborgian theologian Henry James and brother of the novelist Henry James. He studied medicine at Harvard, where he qualified in 1869. He never engaged in practice, but after occupying the chairs of anatomy and physiology at Harvard he devoted himself entirely to psychology and philosophy. From 1889 until 1897 he was professor of psychology and from 1897 until 1907 professor of philosophy at his *alma mater*. During his last years he was chiefly occupied by the study of religion and metaphysics. He is perhaps best known for his championship of the doctrine of pragmatism inaugurated by C. S. Peirce of Cambridge, Massachussets, according to which the value of any assertion is tested by its practical bearing upon human interests and purposes. He died on August 27, 1910. His principal publications were "Principles of Psychology" (1890), "Talks to Teachers on Psychology (1899), "Varieties of Religious Experience" (1902), and "Pragmatism" (1907). Numerous honours were conferred upon him at home and abroad, including membership of the National Academies of America, France, Italy, Prussia and Denmark, doctorate of letters at Padua and Durham, doctorate of laws at Harvard, Princeton and Edinburgh, and doctorate of science at Oxford and Geneva.

## Association of Special Libraries and Information Bureaux

THE sixteenth annual general meeting of the Association of Special Libraries and Information Bureaux was held on December 13, 1941. The chair was taken by the president, Sir Harry Lindsay, director of the Imperial Institute, whose introductory remarks touched on the widening scope of the Association's activities, a subject that was further developed by Mr. E. J. Carter, the honorary secretary, in his review of the year's work. The Association was fortunate enough to come through the winter's air-raids with only minor damage to the office; membership has remained steady and publications continued as usual. New opportunities for service arising from war conditions have been seized, among which was the investigation into the location and supply of scientific and technical periodicals now reaching the country from enemy and enemy-occupied territories, a survey carried out under the auspices of the Royal Society and the Rockefeller Foundation. Further details of the information thus compiled can be obtained on application to the ASLIB Office at 31, Museum Street, London, W.C.1. Other projects for bibliographical co-ordination are being considered.

## Medical History of the War

AN editorial board, under the chairmanship of the President of the Board of Education and composed of representatives of the Fighting Services, the Ministry of Health, the Department of Health for Scotland, the Committee of Imperial Defence and the Medical Research Council, has been set up by the War Cabinet to direct the preparation of a "Medical History of the War". The Board met recently and discussed the scope and planning of this undertaking, the value of which as a record of medical work during the War and of the War's contribution to medical science, will be appreciated. Sir Arthur MacNalty, until recently chief medical officer of the Ministry of Health, has been appointed editor-in-chief. The collection and classification of material for the "History" has now begun. The Editorial Board would be glad to receive copies of published articles, reports and other information from medical officers of health and medical practitioners which may be of use in assembling material for the medical historians; such data should be communicated to the Editor-in-Chief, Medical History of the War, Room 208, Caxton House West, Tothill Street, London, S.W.1.

## Announcements

IT is announced by the New York correspondent of *The Times* that the Mount Palomar Observatory, in California, which is to house the 200-in. telescope, will be closed on January 15 and will remain closed for the duration of the War.

PROF. LOUIS F. FIESER, professor of organic chemistry in Harvard University, has been awarded the Kathleen Berkan Judd one thousand dollar prize of the Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York City, in recognition of his contributions to cancer research. Prof. Fieser's work in this connexion has dealt chiefly with chemistry and synthesis of carcinogenic compounds.

# LETTERS TO THE EDITORS

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

## Lactic Dehydrogenase of Yeast

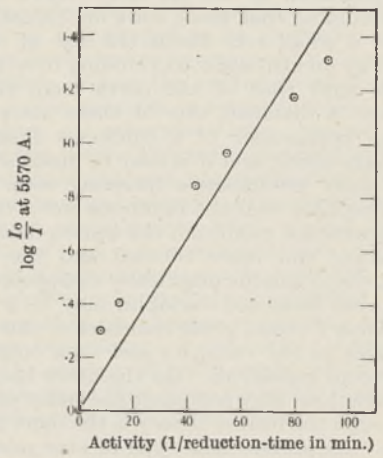
DEHYDROGENASES are of three types: (1) those which act through coenzymes I or II, (2) flavoproteins, and (3) the 'cytochrome-reducing dehydrogenases', a group of enzymes of unknown chemical nature which have the power of reducing cytochrome *c*. The members of the third group are all insoluble and firmly attached to the solid structure of the tissues, with the exception of the yeast lactic dehydrogenase, first extracted from yeast by Bernheim[1]. This enzyme is, therefore, the only one of the group which can be extensively purified with the view of determining its chemical nature. We have carried out such a purification, and have obtained solutions nearly five thousand times as active as those which Bernheim obtained. The following method was used:

Delft baker's yeast is pressed through an ordinary potato masher and air-dried at room temperature. 3 kgm. dried yeast, mixed with 6 l. tap water, are incubated 5 hr. at 38° for autolysis, then 4·5 l. water are added and the residue centrifuged off and discarded. The liquid (6·3 l.) is mixed with 1 l. of alumina Cγ gel (containing 15 mgm. dry weight per c.c.), which adsorbs much coloured material, including most of the cytochrome *c*. The alumina is centrifuged off and discarded. 140 c.c. 50 per cent sodium lactate are added, the fluid heated to exactly 53° for 7 min. and the large precipitate of denatured protein centrifuged off. The liquid (6·2 l.) is mixed with 3·5 l. calcium phosphate gel (containing 20 mgm. per c.c.), centrifuged and the supernatant fluid discarded. The calcium phosphate is then washed five times, each time with 2·5 l. *M*/15 phosphate buffer *p*H 7·2, by thorough dispersion with a mechanical stirrer and centrifuging. Much protein and coloured material, especially flavin compounds, are thus washed out. The calcium phosphate is then eluted three times at 40° with *M*/15 phosphate *p*H 7·2 containing 9 per cent of ammonium sulphate, using 2·8 l. in all. 10 c.c. 5 per cent sodium lactate is added, the solution filtered and then concentrated to 130 c.c. on the ultra-filter, using "4½ per cent" Schleicher membranes. 31 gm. pure ammonium sulphate are added and the precipitate centrifuged off and discarded. A further 18·5 gm. ammonium sulphate are added, the precipitate centrifuged down and dissolved in water to make 53 c.c. The enzyme is freed from cytochrome *c* by ammonium sulphate fractionation in acid solution as follows: 26 c.c. *M*/5 acetate buffer *p*H 4·8 and 53 c.c. water are added to the above red solution, followed by 37 gm. ammonium sulphate. The precipitate is centrifuged off and discarded. 5 gm. ammonium sulphate are then added, the precipitate centrifuged down and dissolved in water to make 10 c.c.

The enzyme is very unstable in the purer stages. The addition of substrate (lactate) improved the stability, as did a high concentration of ammonium sulphate. But even in saturated ammonium sulphate solution the activity of the purest fractions could only be preserved for 2–3 hr.

The purified fractions of the enzyme have lost the power of reacting with cytochrome *c*, though their power of reducing methylene blue is very high. This effect is apparently due to the removal of some intermediate hydrogen acceptor, which acts[2] between the enzyme and cytochrome *c*.

The solution obtained as described above was quite free from cytochrome *c*, but on the addition of lactate gave the spectrum shown in the graph of a preceding communication[3]. As already stated, this is due to a new cytochrome component and its presence suggests the possibility of its being identical with the enzyme. Although definite proof has not yet been obtained, the following points suggest that this is so. (*a*) The new cytochrome is reduced instantly on the addition of a trace of lactate. (*b*) In different preparations the band at 5570 A. always appears when the enzyme activity reaches a certain value. (*c*) Thereafter the strength of the band and the activity increase *pari passu* as the purification proceeds (see accompanying graph). (*d*) Further




evidence is provided by observations on English baker's yeast. The latter cannot be used to prepare the enzyme by the above method, as the enzyme is not liberated by the autolysis, and in order to obtain the enzyme from such yeast a very different method had to be devised. This involved breaking the plasmolysed cells of the fresh yeast by grinding in a ball-mill, warming with toluene, adsorbing on kaolin and eluting with 20 per cent ammonium sulphate, followed by dialysis and adsorption on calcium phosphate as before. When the activity reached the same value as before, the band at 5570 A. again appeared, and in a concentrated fraction obtained in such a way the intensity of the band was approximately that which would be expected from the activity, using the data obtained from the original preparations. No trace of the coenzymes could be detected in the purified preparations by very sensitive tests, and although a trace of flavoprotein was often detectable in solutions obtained by the method described, a slight modification gave active solutions in which no trace of flavin compounds could be detected by the fluorescence test.

While we consider it probable that the cytochrome $b_2$ is identical with the enzyme, the possibility cannot yet be altogether excluded that it is an intermediary acting between the enzyme and methylene blue or other hydrogen acceptor.

Assuming that the enzyme is identical with cytochrome $b_2$, the turnover number of the pure enzyme can be calculated from the activity and the amount of cytochrome $b_2$ present. The figure obtained is

3,100, which can be considered a reasonable value, being in fact identical with the turnover number of crystalline lactic dehydrogenase from muscle[4], though this is no doubt a coincidence, as the two enzymes belong to different groups. The maximum turnover number of cytochrome *c* is 3850[5]. The calculated purity of our final enzyme solutions depends on the assumed molecular weight, but is probably of the order of 10–20 per cent. The $Q_{MB}$ of the pure enzyme would be 30,000–100,000, according to the molecular weight assumed. A calculation from the activity of the Lebedew juice shows that 1 kgm. of yeast contains only a few mgm. of the pure enzyme.

The idea that a cytochrome, or indeed any other hæmatin compound, may act as a dehydrogenase is a new one and may throw light on the nature of other dehydrogenases of the third group.

The work will be reported in greater detail elsewhere.

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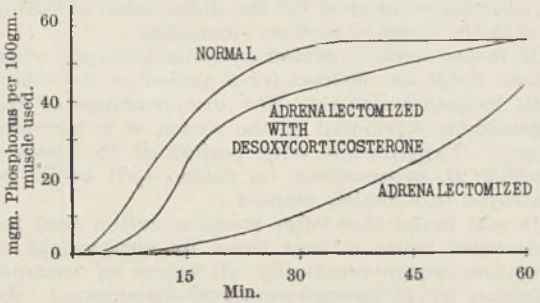
[1] Bernheim, F., *Biochem. J.*, **22**, 1178 (1928).
[2] Dixon, M., and Zerfas, L. G., NATURE, **143**, 557 (1939).
[3] Bach, S. J., Dixon, M., and Keilin, D., NATURE, **149**, 19 (1942).
[4] Straub, F. B., *Biochem. J.*, **34**, 483 (1940).
[5] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **129**, 227 (1940).

## Decrease in Glycogen Phosphorylation in Muscles *in vitro* after Adrenalectomy and Restoration with Desoxycorticosterone

IT has been supposed that a diminution of phosphorylation is the main disturbance after adrenalectomy, and that this is proved by a study of the direct phosphorylation of glycogen by muscle.

If 0·5 gm. of leg muscle of a normal rat is minced and placed in 2 c.c. of a solution of 1 per cent sodium bicarbonate with 1·75 per cent sodium fluoride, then inorganic phosphate is dissolved from the muscle. If 0·25 per cent of glycogen is then added to such a solution, the inorganic phosphoric acid content of the solution decreases and the glycogen is phosphorylated (Bodnár and Tanko, Lohmann, Parnas). The muscles of adrenalectomized rats lose this capacity of phosphorylating glycogen *in vitro*. This was first shown by Schumann (1940), but simultaneously Helve (1940) did not find this difference.

We have studied the time relations of this reaction with the muscles of normal and adrenalectomized rats. Normal rat muscle uses about 54 mgm. phosphorus per 100 gm. of muscle. At 20° C. the reaction ends in 30–60 minutes, and at 37° C. in 10–20 minutes. With muscles of adrenalectomized rats, the reaction is much slower and within the physiological time limit it is strikingly decreased. In thirty-seven adrenalectomized rats only about 11 mgm. phosphorus was used up after thirty minutes. The reaction then slowly continues and may, after three hours, give values equal to those found in normal muscle after thirty minutes at 20° C. or after twenty minutes at 37° C. This explains why Helve, who kept the muscle at 37° C. for 3½ hours, did not observe a decrease in phosphorylation.




PHOSPHORYLATION OF GLYCOGEN BY RAT MUSCLES *in vitro* AT 20° C.

The accompanying figure shows the time relations of the reaction based on mean values of experiments on normal and adrenalectomized rats' muscle at 20° C. The decrease in phosphorylation in the latter is obvious. It is already found in animals which are still only slightly adynamic. Only animals which were still in good condition were used for these analyses. Generally speaking the more time had elapsed after the adrenalectomy, the less phosphorylation occurred. Table 1 gives some values at 20° C. after sixty minutes and at 37° C. after twenty minutes for comparison.

Table 1.

MGM. PHOSPHORUS PER 100 GM. MUSCLE USED.

| | |
|---|---|
| Normal rat muscle (21 animals) ... ... | 45–64 (mean 54) |
| On 4th day after adrenalectomy ... ... | 26, 22 |
| ,, 5th ,, ,, ,, ... ... ... | 36, 36, 22, 40, 22 |
| ,, 6th ,, ,, ,, ... ... ... | 28, 26, 20, 26 |
| ,, 7th ,, ,, ,, ... ... ... | 8, 4, 39, 15, 8 |
| ,, 8th ,, ,, ,, ... ... ... | 6, 20, 16, 18 |

(Each figure refers to a separate rat)

We then tried to restore phosphorylation by adding desoxycorticosterone acetate to these muscles *in vitro*. A 1 per cent solution in 66 per cent propandiol-water was made and 0·1 c.c. added to the system described of 0·5 gm. muscle with glycogen. Desoxycorticosterone restored the decreased rate of phosphorylation with muscle of adrenalectomized rats to the normal rate in all cases (muscles of twelve animals at 20° C., and four at 37° C.); it did not increase the rate of glycogen phosphorylation of normal rat muscle where it was already optimal (three experiments). As a control the action of other steroid hormones, œstradiol and similarly of testosterone, was compared. Neither of these hormones had any action whatever on the rate of phosphorylation, with normal or adrenalectomized rats' muscle.

Table 2.

MGM. PHOSPHORUS PER 100 GM. MUSCLE USED.

| | Desoxycorticosterone (Without) | (With) |
|---|---|---|
| On 4th day after adrenalectomy ... ... | 20 | 36 |
| ,, ,, ,, ,, ,, ... ... | 42 | 54 |
| ,, 5th ,, ,, ,, ... ... | 36 | 64 |
| ,, ,, ,, ,, ,, ... ... | 48 | 68 |
| ,, 6th ,, ,, ,, ... ... | 26 | 40 |
| ,, ,, ,, ,, ,, ... ... | 28 | 52 |
| ,, 7th ,, ,, ,, ... ... | 39 | 62 |
| ,, ,, ,, ,, ,, ... ... | 8 | 30 |
| ,, 8th ,, ,, ,, ... ... | 10 | 19 |
| ,, ,, ,, ,, ,, ... ... | 18 | 30 |

These experiments seem to give a proof that phosphorylation disturbances are the main factor in adreno-cortical insufficiency. It must be emphasized that the restoration took place not in the animal but *in vitro*. A detailed report will be given in *Helvetica Chimica Acta*.

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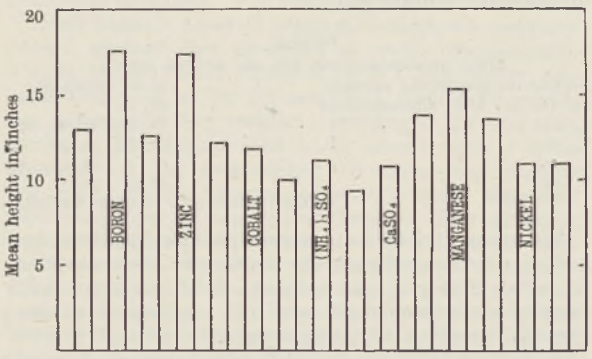
## Trace-elements and 'Potato-sickness'

IT is well known that infestation with the potato strain of the eelworm *Heterodera schachtii* Schmidt is not the sole cause of the disease known as 'potato-sickness'. It occurred to me that some nutritional deficiency might be a contributory factor. The disease nearly always occurs on land on which potatoes have been grown continuously for a number of years, and it seemed possible that this might well lead to the soil being exhausted of certain vital elements required by the plant in small quantities and normally neglected in manurial treatments and soil analyses. A small-scale attempt to test this hypothesis was made during 1941 and some promising results obtained. These, however, were of a preliminary nature and a more extensive investigation is planned for the future. A detailed account of this year's work is now in preparation; in the meantime it was thought advisable to publish the following note in the hope that it might be of use to other workers who may be interested in the problem.




MEAN HEIGHTS OF THE GROUPS OF FIVE PLANTS IN THE MOST DILUTE ZONE SHOWN IN THEIR RELATIVE POSITION IN THE PLOT. UNTREATED ROWS ALTERNATE WITH TREATED ROWS. THE ROW MARKED '$CaSO_4$' RECEIVED A HEAVY DRESSING OF THIS SUBSTANCE IN POWDER FORM IN THE DRILL AT THE TIME OF PLANTING. SIX OTHER ROWS OF PLANTS IN A SEPARATE BLOCK ARE NOT SHOWN IN THIS FIGURE.

A small plot of land, badly infested with *Heterodera schachtii*, was planted with a series of rows of potatoes, each row containing fifteen plants. Some of the rows were watered, at weekly intervals, with dilute solutions each containing a single salt of certain of the trace-elements. The strength of the solution was halved for each successive group of five plants in the row. Three strengths of the various solutions were thus used, and of these, the solution applied to the second five of the fifteen plants was of the same strength as that contained in the solutions used by Arnon in his work on the effect of trace-elements on the growth of lettuce and asparagus seedlings[1]. Treated and untreated rows alternated throughout most of the plot, so that there was, in general, an untreated row on each side of a treated row. Certain of the rows were treated with ammonium salts of similar dilution to act as general controls and also to control any possible effects of the anions of the salts of the various trace-elements used.

The heights of all the plants were measured when flowering began, when it was noticed that all the plants were at the same stage of maturity. The crop was lifted when the last of the tops had died down, and the tubers of each plant weighed.

Weight of crop and height of plant were in general agreement.

The mean height of each group of five plants in the rows varied with the dilution of the solution used, the plants being considerably taller in the zone to which the strongest solutions had been applied, and shortest where the most dilute solutions had been used. The most striking *differences* between treated and untreated plants were shown, however, in the latter zone. For example, the mean height of the plants treated with the most dilute solution of zinc sulphate was 40 per cent greater than the mean height of the untreated plants on each side of them. A similar difference was also found in the case of boric acid, and a smaller, but quite marked, difference in the case of manganese chloride. Yet these treated plants had received extremely minute amounts of the trace-element. For example, *throughout the whole season*, the total quantity of boron supplied to each of the plants treated with boric acid was about 0·5 mgm., while the total quantity of zinc supplied to each plant treated with zinc sulphate was about 0·05 mgm. It is certain that the increases in height were not due to the water supplied, for the differences are just as marked when the treated plants are compared with plants treated with water alone or with those treated with the dilute solutions of the various ammonium salts. Some of these points are clearly shown in the accompanying figure.

The plants treated with the more concentrated solutions showed the same general effects, save that the percentage differences between treated and untreated plants were not so large. It is probable that, under the conditions of the experiment, the treatments spread to the adjacent untreated rows and that this tendency was greater the stronger the solution used. It was also evident that the plot was by no means homogeneous in degree of infestation with eelworm, but although this would help to explain the fact that the tallest plants were all found in the zone to which the strongest solutions had been supplied, it cannot account for the marked differences between the treated plants already referred to and those immediately adjacent to them.

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[1] Arnon, D. I., *Amer. J. Bot.*, **25**, 322 (1938).

## Cotton Seed Disinfection in War-time

IN the Sudan cotton seed has to be treated with a mercurial dust for the control of blackarm (*Bacterium malvacearum* E.F.S.), present on the seed as an external infection[1,2].

On the outbreak of war the possibility arose of there being a shortage of mercurial dusts in the country. It therefore became expedient to provide an alternative method for the disinfection of cotton seed in the event of such an emergency.

*B. malvacearum* in cotton debris is destroyed when cotton fields are flooded for a period of four days with irrigation water[3]. The disappearance of the organism is attributed to the action of a bacteriophage. Experiments were performed to discover whether *B. malvacearum* on cotton seed could be destroyed in a similar manner.

It was found that after steeping cotton seed for forty-eight hours in four times its own weight of irrigation water practically all traces of external infection by *B. malvacearum* had disappeared. In small-scale plant-house experiments on seed which

when untreated gave 14 per cent infected plants, complete control of the organism was obtained. A larger field experiment, using infected seed from the same source, gave 0·26 per cent infected plants after the steeping treatment, and complete control after using a mercurial dust, Abavit B.

Germination of the seed is depressed by the steeping treatment, but not seriously so. In a field experiment unsteeped seed gave 79 per cent germination, and steeped 72 per cent. The steeped seed had been dried and stored for a short period after treatment. If the steeped seed cannot be sown wet immediately, and has to be dried and stored, the drying process must be rapid and thorough. Otherwise the seed will promptly germinate.

From laboratory experiments it would appear that the organism disappears from the surface of the seed during steeping, not through the activity of a bacteriophage, but through exposure to anaerobic conditions. These conditions are the result of bacterial activity, and oxygen absorption by the germinating seeds. The growth of *B. malvacearum* in culture is closely conditioned by the amount of oxygen present.

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[1] Massey, *Emp. Cot. Grow. Rev.* **14**, 301 (1937).
[2] Clouston and Andrews, Rep. Agr. Res. Serv. (1938).
[3] Massey, Rep. Gezira Agric. Res. Serv. (1933 and 1934).

## Scattering of Neutrons in Deuterium

USING the neutrons released in the beryllium-deuterium nuclear reaction, we have investigated the scattering of medium fast neutrons in deuterium gas. The bombarding deuteron beam of 4 micro-amperes was accelerated with a peak voltage of 600 kilovolts in a short ion path tube[1], using the 1 Mv. cascade transformer at the California Institute of Technology. The neutrons emitted in a direction perpendicular to the bombarding deuteron beam traversed a brass pressure ionization chamber filled with deuterium gas at 7 atmospheres. The energy of the recoil deuteron was measured by a linear amplifier which fed a mechanical oscillograph, the pulses being recorded on a moving film. Calibration pulses were registered on the same film with a thyratron pulse generator and a standard condenser. More than 4,000 tracks were measured, the longest pulse track corresponding to an energy of 2 Mev. The curve giving the distribution in energy is shown in Fig. 1.

The maximum at 1·2 Mev. may correspond to the

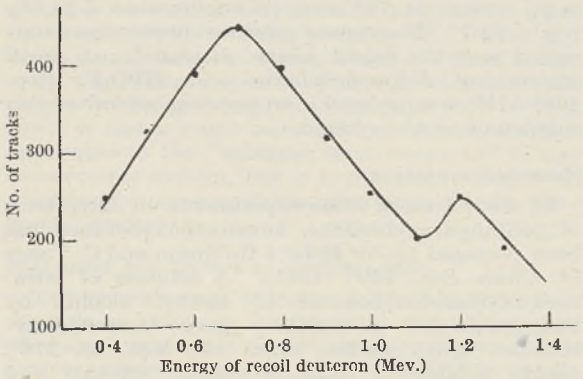


Fig. 1.

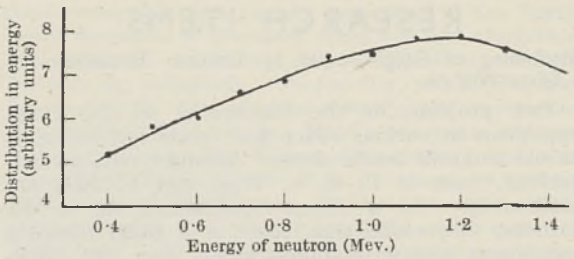


Fig. 2.

peak energy of the low-energy group of neutrons[2] released in the beryllium-deuterium reaction. The more prominent maximum at 0·7 Mev., presumably, is due to an anomaly in the neutron-deuteron interaction. It may be associated with the "Ramsauer effect" deduced[3] by Massey and Mohr on the basis of a potential interaction of range $4{\cdot}5 \times 10^{-13}$ cm. Assuming the approximate validity of the equation deduced by Baldinger *et al.*[4] for the distribution in energy of the primary neutrons in terms of the energy distribution of the recoil nuclei, the curve in Fig. 2 has been plotted with the cross-section values given by Massey and Mohr (*loc. cit.*). The graph indicates a wide spread of energy in the neutron beam, which gets scattered in the gas contained in the ionization chamber. The anomaly at 0·7 Mev. may also be associated with the critical wave-length $\lambda_{cr} = 5{\cdot}4 \times 10^{-13}$ cm. deduced by Bethe[5] on the basis of a continuum theory of the compound nucleus. As recently stressed by Massey and Buckingham[6], further experimental data may be needed to establish the nature of fundamental nuclear forces.

The details of our experimental work will appear elsewhere.

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[1] Stephens and Lauritsen, *Rev. Sci. Inst.*, **9**, 151 (1938).
[2] Bonner and Brubaker, *Phys. Rev.*, **50**, 308 (1936).
[3] Massey and Mohr, *Proc. Roy. Soc.*, A, **148**, 206 (1935).
[4] Baldinger, Huber and Staub, *Helv. Phys. Acta*, **11**, 245 (1938).
[5] Bethe, *Phys. Rev.*, **57**, 1125 (1940).
[6] Massey and Buckingham, NATURE, **146**, 776 (1940).

## Anomalous Viscosity of Lubricating Oil at High Velocity Gradients

AN analysis of data recently put forward by Spiers[1], on the flow of oil through engine bearings, shows that the results cannot be reconciled with the usual hypothesis of a viscosity coefficient independent of the velocity gradient. The data indicate that at velocity gradients between $10^4$ and $10^6$ sec.$^{-1}$, the viscosity coefficient falls down to a small fraction of its normal value. This effect is in agreement with experiments carried out by me in 1937[2]. It is presumably due to orientation under shear, an effect well known for particles of extreme anisometry such as those of cellulose and tobacco mosaic virus.

The analysis of Spiers's data will be published shortly. Experimental work on the problem is in hand.

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College of Technology, Manchester, 1. Dec. 18.

[1] Spiers, *J. Inst. Auto. Eng.*, vii (Jan., 1941).
[2] Neale, *Chem. & Ind.*, 140 (1937).

# RESEARCH ITEMS

### Blackening of Golgi Bodies by Osmium Tetroxide and Silver Nitrate

THE problem of the blackening of the Golgi apparatus in various silver and osmic techniques is an old and still unsolved one. Among recent investigations those of P. B. v. Weel and E. Ries are interesting. In a recent communication to the Editors, they claim that there is a Golgi complex containing certain granules which they call "lipochondria", which at some stages produce osmiophilic substances, and are associated with the fatty Golgi substance, which always reduces osmium tetroxide, and has certain adsorptive capacities. Weel notes that after feeding a starved frog (in the cells of the intestine of which a clearly marked reticular Golgi apparatus is present) on peptone and glucose, the reticulum disappears, and is rebuilt again at the end of the resorptive process. But with feeding on fructose, no alteration of the reticulum was noted. Weel insists that the Golgi substance contains fatty materials which are used and consumed by the cell in certain periods of activity. The results of Weel and Ries are sharply at variance with those of G. Chr. Hirsch, who believes that the blackening is due to an adsorption of reduced osmium, silver or iron, and not to any chemical action. While Weel's view, that the osmium tetroxide reaction is a chemical one with lipins existing in the Golgi apparatus, will meet with a considerable body of support, the presence of "lipochondria" seems more doubtful. The papers of Weel and Ries will be found in the *Z. Zellforsch.* and the *Z. vergl. Physiol.* of 1936–1939.

### Salmon of the Owenduff (Ballycroy) River

A. W. E. J. WENT, of the Department of Agriculture, Fisheries Branch, Dublin, (*Proc. Roy. Irish Acad.*, **47**, Sect. B., No. 6; 1941) has investigated the fishes in this river—a good one for small salmon and sea-trout. The records for the most part depend on scales from rod-caught fish, but give a fairly accurate impression of the stocks of salmon. The bed of parts of the main river and its tributaries which are frequented by salmon and trout consists mainly of gravel, and good spawning facilities are available. The material for the research consisted of more than a thousand sets of scales and data taken from the rod-fisheries of the Owenduff River during the fishing seasons of 1930–1939 inclusive, and 106 similar sets from the net fishery in the estuary of the river in 1938, together with some data from the main tributaries. Owenduff is essentially a small salmon river and the bulk of the fish have spent two years or less feeding in the sea. Of the maiden fish 94 per cent migrated as two-year old smolts and 5·5 per cent as three-year old smolts. Grilse and small spring fish formed 75·8 of the total catch. Previously spawned fish amounted to 4·9 per cent of the total number. The growth of salmon and sea-trout up to the end of the second year in the sea in the two- and three-year smolt classes are compared. The growth-rate of the salmon in fresh water is considerably less than that of the sea-trout. On the other hand, in the sea the growth-rate of the salmon is very much greater than that of the sea-trout. "Although the sea-trout start life in the sea with an initial advantage in length of over 2 inches, by the end of the first winter in the sea the salmon are on an average about 7 inches longer than the sea-trout. This advantage is more than maintained in the second year in the sea."

### Microlepidoptera of Ireland

THE study of these small moths has been comparatively neglected in Ireland, and generally it is the larger species of the Microlepidoptera that are best known. It appears that the Tortricidæ and Lamproniadæ are the best-worked families, and the most neglected are the minute Nepticulidæ. B. P. Beirne has published an up-to-date list of all the species so far known or believed to occur in Ireland (*Proc. Roy. Irish Acad.*, **47**, Sect. B, No. 4). He records 709 species or 54 per cent of the British Microlepidoptera. Of these, 105 species are bracketed as incorrect or doubtful, thus leaving 46 per cent definitely recorded. The classification followed is that of Meyrick, which has been corrected and brought up to date. In describing the distribution of each species, the county-divisions of Praeger, as used in his "Irish Topographical Botany", are followed. In a country that has been so little explored for these insects remarks on the abundance or otherwise of a species are usually not very reliable. It appears that the best-worked county is Dublin, and along with Wicklow and Kerry these three counties are the only ones explored for the smaller species. This carefully prepared list will prove of great assistance to future collectors and observers, who will also find the bibliography at the end very helpful.

### Transmission of Monosomics

W. H. GREENLEAF (*Proc. Nat. Acad. Sci.*, **27**, 427–430; 1941) has analysed the transmission of *n*-1 gametes through the ovule of the monosomic-*P* of *Nicotiana tabacum*. Although a ratio of 3 monosomics to 1 normal plant is expected, only 4 per cent monosomic–*P*, are found. There is no Renner effect; every embryo sac is formed from the megaspore at the chalazal end. There is, however, a reduction in the number of seeds in a monosomic, and the author shows that the embryo-sacs arising from *n*-1 megaspores are much delayed in development as compared with normal. He suggests that delayed pollination might increase the proportion of monosomics in the progeny.

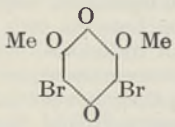
### Phosphorus Trifluoride and Oxyfluoride

THE reactions between phosphorus pentoxide and simple fluorides and chlorides and with fluorapatite have been studied by G. Tarbutton, E. P. Egan and S. G. Frary (*J. Amer. Chem. Soc.*, **63**, 1782; 1941) and the physical properties of $PF_3$ and $POF_3$ have been re-examined. The melting and boiling points found are: $PF_3$, m.pt. −151·5°, b.p. −101·8; $POF_3$, m.p. −39·1° at 785 mm. (it sublimes at −39·5°), b.p. −39·7°. The vapour pressure curves were determined and the latent heats calculated. A small amount of difluophosphoric acid $HPO_2F_2$ (b.p. 108°–111°) was isolated; no previous record of this compound could be found.

### Hexamethoxybenzene

IN the course of some experiments on derivatives of pentahydroxybenzene, hexamethoxybenzene has been prepared by Sir Robert Robinson and C. Vasey (*J. Chem. Soc.*, 660; 1941). A solution of tetramethoxydiacetoxybenzene in methyl alcohol by hydrolysis and methylation gave hexamethoxybenzene, white needles, m.pt. 81°, b.pt. *ca.* 278°, readily soluble in common organic solvents and moderately readily soluble in water; it can be

recrystallized from hot water. The starting substance for the preparation of the tetramethoxy compound was dibromodimethoxy-*p*-benzoquinone:




This was converted by sodium methoxide in methyl alcohol into tetramethoxy-*p*-benzoquinone, and by the action of zinc dust in acetic acid-sodium acetate solution the tetramethoxydiacetoxy compound was obtained. Hexahydroxybenzene is also formed by another process described by W. Baker (*J. Chem. Soc.*, 663; 1941).

### Steady Flow of a Viscous Fluid through a Leaky Tube

THE classical work of Poiseuille on the steady flow of a viscous liquid through straight tubes of uniform circular section and with impervious walls is not directly applicable to conditions arising in biological problems. Here a similar flow occurs through tubes with membranous walls such as the fine capillaries through the walls of which nutritious fluids get from the blood to working (for example, muscle) cells. F. J. Turton (*Phil. Mag.*, 32, 457; 1941) gives a theoretical treatment of this type of problem applicable to data supplied from the Cambridge Biochemical Laboratory by J. F. Danielli. The investigation shows that with leaky walls the pressure gradient may approximate closely to the constancy found with non-leaky tubes, but for certain conditions known to exist in practice, the mathematical results show considerable departure from constant pressure gradient. At the end of the paper the author offers to help any biologist wishing to use the mathematical results.

### Solutions of Wave Equations

PROF. E. SCHRÖDINGER, now at the Dublin Institute of Advanced Studies, invites the collaboration of mathematicians in the detailed investigation of certain new types of wave equation. He points out (*Proc. Roy. Irish Acad.*, 47, 1; 1941) that a decisive advance in quantum theory was made in 1934 by the hypothesis of E. Fermi. This asserts that just as Maxwellian waves are descriptive of the motion of light-quanta, but responsible for the forces between electrically charged particles, so the wave fields of de Broglie-Schrödinger-Dirac are descriptive of electrons but responsible for a new kind of forces between heavy particles. The mathematical expression of this leads to wave equations of a new type, and it is very desirable that the solutions of these equations should be fully investigated. A method which seems likely to be very useful is that of taking mean values over a sphere. This method reduces the number of independent variables from four to two. There is also a much more general method which is applicable to the "enlarged wave equation" of any conservative system, but it is not clear whether, in practice, this is as useful as what appear to be more special devices.

### Magnitudes and Colours of Northern Stars

THE measurement of stellar brightness and colour depends so much on instrumental and atmospheric conditions that photometric catalogues prepared at various observatories are apt to exhibit large discrepancies. The establishment by the International Astronomical Union, twenty years ago, of the North Polar Sequence of standard stars was not altogether successful in removing these difficulties, mainly because the standards were too few, too bright, and too scattered. The obvious remedy was to increase the number of standards. Nearly ten years work to this end at the Mt. Wilson Observatory has now culminated in the issue of a Catalogue (Carnegie Institution of Washington, Publication 532; 1941) of magnitudes and colours for 2,271 stars north of declination $+80°$. Work on the new catalogue began by a systematic intercomparison of nine well-known polar catalogues; the provisional magnitudes so deduced prepared the way for the reduction of the more recent photographic observations (more than a hundred plates) on which the catalogue chiefly depends. These plates were taken with the 5-inch Ross camera at Mt. Wilson, and were measured in thermo-electric photometers. The limiting magnitude adopted was that of the B.D. Catalogue, roughly 11·0 photovisual. The magnitudes catalogued, photographic and photovisual, are given to two decimal places, and are weighted means of the new data and the older catalogue values, though the new values are also given separately. The probable error of a catalogue entry is about $\pm 0{\cdot}012$ mag. for a photographic, and $\pm 0{\cdot}015$ mag. for a photovisual value. These definitive magnitudes seem likely to supersede the old standards at once; and the scope of the catalogue is such that they may have an even longer life than the values they displace.

### Polarization of the Corona

G. W. ALLEN has published a paper (*Mon. Not. Roy. Astro. Soc.*, 101, 5; 1941) which contains the polarization observations made on the solar corona by the Australian Eclipse Expedition to South Africa on October 1, 1940. The chief object of the investigation was to determine to what extent the polarization of the corona varied with colour. The camera was fitted with a 6-inch Dallmeyer lens of focal length 36 inches. It was fed from an 8-inch cœlostat with silvered mirror and gramophone motor drive. About an inch in front of the plate a $2\frac{1}{2}$-inch disk of 'Polaroid' was placed in such a way that it could be rotated through 90°, and it was oriented to rotate from a polar to an equatorial direction. Interchangeable blue and red filters were mounted between the plate and the 'Polaroid' and two exposures were made on each plate, one with the 'Polaroid' oriented in a polar direction and the other with equatorial 'Polaroid'. One great difficulty in corona photometry arises from the correction for fogging by extraneous light, and at great distances from the sun on the long exposures this extraneous light was much brighter than the corona. The calibration of the photographic plates was effected by the use of a platinum step wedge placed in contact with the plate, and exposure was made inside the camera with the same colour filters, 'Polaroid' and plates as were used for the eclipse. A full description is given of the measurements of the photographs with the Radcliffe Observatory, Pretoria, photo-electric microphotometer, of corrections which were made owing to the incompleteness of the polarization of the 'Polaroids', etc. It was found that the polarization of the corona was practically independent of colour from 4600 A. to 6250 A. and also that it was almost independent of limb distance from 7′ to 40′. The degree of polarization was 41 per cent for red and 43 per cent for blue light.

# HETEROTHALLY AS AN OUT-BREEDING MECHANISM IN FUNGI

By DR. K. MATHER

John Innes Horticultural Institution

ALL organisms are dependent on a supply of heritable variation for future adaptive changes; but the presence of free variation means that some members of the population show a poor adaptation to existing circumstances. The balance between present and future adaptation is thus conditioned by the amount of heritable variation which the population can maintain. This, in its turn, depends on the system of breeding or mating in force in the species. Where close inbreeding is in force the individuals tend towards a high degree of homozygosity. Heritable variation is then reduced to a low level, with the result that present adaptation is good but the prospect of future adaptation to changed circumstances poor. When, on the other hand, outbreeding is the rule, great genetical heterogeneity is maintained and in consequence the chances of good future adaptation are improved at the expense of present fitness[1]. In this way genes which control or affect the breeding system of a species have a profound effect on its genetical structure and evolutionary history. They have an adaptive value and will be subject to evolutionary changes.

Many genetically controlled breeding systems have been recognized, and some partly analysed, in the higher plants. Sex separation, incompatibility and heterostyly are now well known as outbreeding systems which depend for their action on genetical diversity in the population. In each case the action of the mechanism is by the reduction of effective mating between genetically like zygotes, while genetically unlike individuals intercross with relative freedom. In the extreme, and most common, case this reduction is complete, though in other cases it may only be partial. The extent of the reduction is itself subject to further genetical control[2]. Since male and female gametes are always distinct haploid individuals, the achievement of wide outbreeding is ensured by the complete prevention of fusion between gametes from the same zygote. All three of the mechanisms mentioned render this possible.

Though showing the same genetic organization as Angiosperms, the fungi, and indeed nearly all lower plants, may be expected to present somewhat different types of breeding system for two chief reasons. In the first place the mating behaviour is a property of the haploid phase in the life-cycle, unlike the situation in the higher forms where the diploid zygote plays such a predominant part. The genes determining the breeding system in fungi must act solely in the haploid, after it has become freed from the influence of the parent zygote. Secondly, a given haploid individual may produce both male and female gametes, or, amounting to the same thing, gametic differentiation may be lacking, in contradistinction to the higher plants where the haploid phase is almost non-existent except in the form of the individual gamete. In view of these differences it is very instructive to consider the type of genetically controlled outbreeding system which might be operative in lower plants, and Buller's recent review of heterothally in fungi[3] provides a very suitable opportunity.

What kind of breeding system, involving genetical diversity, might be expected *a priori* in fungi?

The first essential of any outbreeding system in a species with an independent haploid phase is the prevention of fusion between two gametes produced by a single haploid individual. (It may be noted in passing that this occurrence would lead to a more rigorous inbreeding than is ever possible in a species having a predominant diploid phase, as such self-mating gives immediate homozygosis.) Assuming that the same broad possibilities of cell behaviour exist here as in the Angiosperms, self-mating of a haploid may be prevented in either of two ways. The male and female gametes, if distinct, may be isolated on different haploids or an incompatibility gene may operate in such a way that only haploids carrying unlike allelomorphs can mate. Where gametic differentiation is not present the former possibility is ruled out; but in any event the two systems have a similar genetical basis, for each depends on the production of two (or, in the second case, possibly more) genetically distinct haploids, the allelomorphs determining the two groups acting so as to prevent mating of like types.

Whether the action is one by which allelomorph $A_1$ gives a haploid with male gametes and $A_2$ one with female gametes, or whether the action of $A_1$ and $A_2$ is of the physiologically unanalysed type known in the higher plants by the name of incompatibility, is genetically immaterial. In either event the matings $A_1 \times A_1$ and $A_2 \times A_2$ are impossible and self-mating of a single haploid is ruled out. Prevention of self-mating in its simplest form requires only two allelomorphs $A_1$ and $A_2$. The existence, possible with an incompatibility system, though not with sex separation, of more than two types of haploid does, however, have an advantage over the two-group system when we turn to the next aspect of inbreeding prevention, namely, the control of mating between haploids having a recent common ancestry.

Even if self-mating is prevented, a considerable measure of inbreeding is possible provided that haploids deriving from the same diploid zygote, where, it should be remembered, the all-important recombination occurs, can mate as freely, or more freely, *inter se* than they can with haploids descended from other zygotes. Inbreeding at this level cannot be prevented or even reduced by any system of incompatibility or sex-separating genes consisting solely of allelomorphic pairs. Where a single allelomorphic pair exists all the zygotes must be $A_1A_2$ and will give $A_1$ and $A_2$ haploids. Furthermore, all the zygotes will give equal proportion of $A_1$ and $A_2$ haploids; so in any population the ratio which the numbers of $A_1$ haploids deriving from a given zygote bears to the number of $A_1$'s from other zygotes will on the average be the same as the ratio of the $A_2$ haploids contributed by these various zygotes. Hence an $A_2$ gamete will find possible mates from different zygotes in the proportions of the contributions of any kind of spore by those zygotes to the population. The same will be true of the mating choice open to $A_1$ haploids and so the relative rate of mating between sister haploids from the same zygote is independent of the existence of the two allelomorphs, $A_1$ and $A_2$.

Thus all that this pair of allelomorphs does, other than to prevent self-mating, is to halve the number of possible mates for a given haploid individual in the population. It can mate with half its sisters, that is, with the $A_2$'s if it be $A_1$, or $A_1$'s if it be $A_2$, just as it can mate with half the haploids from any other zygote.

Two elaborations of this simple system are possible *a priori*, one of which will decrease the frequency of mating between sister haploids and the other of which increases the frequency of mating between non-sisters. The first one is the introduction of a second independent locus *B*, such that $B_1 \times B_1$ and $B_2 \times B_2$ are impossible matings while $B_1 \times B_2$ is possible. This new gene has, in fact, just the same action as the gene *A*. All zygotes must be $A_1A_2B_1B_2$ and will produce four types of daughter haploid, $A_1B_1$, $A_1B_2$, $A_2B_1$, $A_2B_2$. Only two matings are possible between the four, namely, $A_1B_1 \times A_2B_2$ and $A_1B_2 \times A_2B_1$, all the others being prevented either by gene *A* or by gene *B*, or, of course, by both. Self-mating is, obviously, also impossible. Any given haploid can mate with only one of the four types, so that only one quarter of the possible combinations in pairs are fertile in the sense that they can give progeny. This compares with the half given by a single gene. When a third member, *C*, is introduced the freedom of mating is reduced to one eighth.

This type of elaboration certainly reduces the chance of a successful mating between haploids from the same zygote, but, as all zygotes must be $A_1A_2B_1B_2$, it equally reduces the chance of successful mating between haploids from different zygotes. The latter may, however, be increased by the second elaboration. So far in the argument each gene has comprised two allelomorphs, but if a multiple allelomorphic series exists at each locus the freedom of non-sister mating is increased. Suppose that locus *A* has three allelomorphs, $A_1$, $A_2$ and $A_3$. Three types of zygote will occur, namely $A_1A_2$, $A_1A_3$ and $A_2A_3$. A haploid can mate with only half its sisters from the same zygote, but it can mate with more than half its non-sisters ; for one type of zygote, and, it must be noticed, the most unlike and hence the most distantly related, type of zygote, gives daughter haploids with all of which the first haploid is fertile as it differs genetically from them all. When the three types of zygote are equally frequent the non-sister pairs can mate in 2/3 of cases as compared with the sister mating figure of 1/2. When there are four allelomorphs still more types of zygote are possible and non-sister mating is again increased to 3/4. Non-sister mating increases as the number of allelomorphs increases, but sister mating remains at 1/2.

This increase in the freedom of non-sister mating may be combined with decreased sister mating if several genes each of several allelomorphs are in operation. With two genes each of three allelomorphs, that is, $A_1\ A_2\ A_3$ and $B_1\ B_2\ B_3$, all allelomorphs being equally frequent in the population, sister mating occurs in 1/4 of cases and non-sister mating in 4/9, giving a non-sister : sister ratio of 16 : 9. This compares with 4 : 3 when only one gene of three allelomorphs is in control. With two genes of four allelomorphs the ratio is 9 : 4, that is, the rate of outbreeding as measured by relative frequency of non-sister and sister mating is once again increased. Thus by a combination of several unlinked incompatibility loci each with several allelomorphs a high rate of outbreeding can be achieved. It may be noted, however, that mating between haploids from the same zygote can never be completely prevented in the way that any of the three breeding systems mentioned earlier for higher plants completely prevents it. To do this would require that the diploid phase could implant in all its daughter haploids some single incompatability character which overrode their own constitution and determined their behaviour in mating. This is in fact done by higher plants [2,4], but, perhaps as a result of the lower degree of organization of diploid life, has not, so far as I know, been encountered in any lower plant.

When Buller's review is examined in the light of this system, built up from principles developed to explain the behaviour of Angiosperms, it will be seen that all levels of elaboration, and hence of controlled outbreeding, are found.

In forms like *Coprinus lagopus* and *Schizophyllum commune* the complete system involving multiple allelomorphic series at more than one locus is found. It may be remarked that, when viewed in this new light, the true nature of the so-called sexual races of these fungi is very clear. They are no more races than are any pair of fully cross-compatible plants in species like the sweet cherry and the red clover. The different diploid fruit bodies, which, by being fully inter-fertile, gave rise to the idea of sexual races, are seen merely to have different allelomorphs at each of the incompatibility loci which, taken together, control the breeding system. The next generation from a cross between such diploids would contain sister zygotes which, on this criterion, could equally well be classed as belonging to different sexual races. It can be predicted that a suitable search should bring to light wild fruit bodies which have one allelomorph in common at either or both of the loci. These would exhibit an inter-fertility which, though incomplete, would be greater than that observed when haploids from the same fruit body are interbred. Such a find would complete the evidence for the artificiality of the sexual race concept.

There are also examples of intermediate elaboration where only one incompatibility locus is found. Though apparently less fully investigated from the point of view of multiple allelomorph detection, at least one of these species, *Coprinus rostrupianus*[5] has such a series. No doubt other cases could be found without much difficulty.

The last stage of control is shown by fungi such as the heterothallic Mucor species where a single gene of two allelomorphs prevents self-mating but where the degree of outbreeding beyond this point is a matter of chance. Sometimes this mechanism appears to survive as a relic after another form of control has been superimposed. Such a case is provided by certain Ustilago sp., for example, *U. hordei*[6] where the four products of meiosis unite in pairs in the single-celled stage, at which self-mating would appear to be ruled out in any case. An inbreeding system has been developed by the retention of the four spores in such a way that the most likely pairings are those between unlike products of the same meiosis, that is, of the same diploid zygote. It would appear that this is an example of adaptation to secure an intermediate degree of inbreeding similar to those obtaining in higher plants like Triticum and Pisum. In these higher plants, too, the present inbreeding mechanism has been superimposed on an outbreeding system, the relics of which may still be observed.

Lastly, there are the cases where heterothally is not found and self-mating may occur. Such homothallic species are capable of rigorous inbreeding, but this may be controlled at an intermediate level by a display of incomplete or partial heterothally. When this happens a haploid is capable of self-mating, that is, of homothallic behaviour, but will

in particular circumstances show a preference for mating with other individuals, that is, show heterothallic behaviour. It is as though the individual possessed partially effective heterothally genes. In this way a balanced inbreeding-outbreeding system can be maintained.

It is also possible that such behaviour exists as a stage in the transit between full homothally and full heterothally. In *Primula sinensis*[2] and Petunia sp.[7] the efficiency of the key outbreeding genes is probably controlled by modifying polygenes. The main genes for heterostyly in the one case and for incompatibility in the other may then give either increased or decreased outbreeding by selection of the polygenic complex. Though not yet proved, it seems likely that selection could even reduce the efficiency of the outbreeding genes to zero, that is, completely to remove their power of affecting the breeding system. If this is so, it is easy to see that polygenic selection could lead to the gradual development of an adaptive breeding mechanism. The intermediates between homo- and heterothallic behaviour are susceptible to a similar interpretation and this could be tested by suitable selection experiments. The question of how a + and a − nucleus can occur in different parts of the same homothallic haploid then resolves itself, as, on this view of polygenic modification, the nuclei, though capable of developing heterothallic behaviour, will not inevitably possess a 'sex'.

Such a brief survey forbids the detailed mention of special cases, but it can be seen that the complications of heterothally fit into an ordered scheme when viewed as adaptations to the control of outbreeding. Basically, the function and genetical structure of heterothally are the same as those of systems found elsewhere. The superficial differences are imposed by peculiar circumstances arising from the existence of an independent haploid phase.

[1] Mather, K., *J. Genet.*, **41**, 159 (1941).
[2] Mather, K., and de Winton, D., *Ann. Bot.*, N.S. **5**, 297 (1941).
[3] Buller, A. H. R., *Bot. Rev.*, **7**, 335 (1941).
[4] Riley, H. P., *Genetics*, **21**, 24 (1936).
[5] Newton, D. E., *Ann. Bot.*, **40**, 105 (1926).
[6] Huttig, W., *Z. Bot.*, **24**, 529 (1931).
[7] Mather, K., unpublished.

## HALLEY'S WORK AS A GEOGRAPHER

THE remarkable progress made in geography in the seventeenth and early eighteenth centuries owed much to a distinguished band of scholars at Oxford. This progress was made in two branches of the subject. On one hand, there was a large output of cosmographical works in which the authors, who were also teachers at Oxford, tried to present the rapidly growing geographical knowledge of the world. On the other hand, mathematicians developed that side of geography which was closely related to navigation. It was one of the duties of the Savilian professor of astronomy to deal particularly with this aspect of the subject, although in practice his colleague, the Savilian professor of geometry, seems to have been equally interested and active. Halley held the chair of geometry, and the more important part of his contribution to geography is attractively dealt with by Prof. S. Chapman in his paper "Edmund Halley as Physical Geographer and the Story of his Charts" (*Occasional Notes, Roy. Astron. Soc.*, No. 9, June, 1941).

In addition to the work described by Prof. Chapman, Halley contributed some geographical papers to the Oxford Philosophical Society, made a survey of the tides of the English Channel, and undertook a journey to the Adriatic Sea. He is, however, best known for his charts, and with these Prof. Chapman deals fully, illustrating his paper by some excellent reproductions and by three isogonic charts of different periods. He also disposes of the claim that Halley explained correctly the physical causes of the trade winds.

At the end of his paper, Prof. Chapman refers to the geographical inaccuracies of Halley's charts. These, as he points out, were "due mainly to the necessity to estimate longitude". Soon after Halley's maps were published, the cartographical researches of G. Delisle led to great improvements, while before he died John Harrison had invented the chronometer and so had made possible the accurate determination of longitude. Prof. Chapman also refers to certain "geographical curiosities" on Halley's maps, including the courses of certain rivers in Asia and Africa. It should be recalled that when Halley wrote there had been very little exploration of Asia and practically none of Africa. Geographers, in the case of the latter continent, had to rely largely on classical tradition and the work of Leo Africanus. How great was the ignorance and the fascination of the Dark Continent can be read in Defoe's story of the adventures of Captain Singleton.

Prof. Chapman's paper is timely in appearance, for the two hundredth anniversary of Halley's death is being commemorated this year. Halley held his Savilian chair until his death and did much to promote the study of applied geography. It is too much to say, as does the "Dictionary of National Biography", that he laid the foundation of physical geography but, none the less, his work was substantial and of lasting value: to it Prof. Chapman does full justice.

J. N. L. BAKER.

## NOMENCLATURE OF *Cl. welchii* 'TOXINS' TYPE A

THE investigation of the toxins produced by *Cl. welchii* type *A* (classic gas gangrene of man) has led to the recognition of the complex nature of the soluble substances recovered from filtrates of cultures of this organism. The attempt to analyse these substances into their component elements has led to certain unfortunate confusions in the nomenclature, as pointed out by Llewellyn-Smith[1].

In view of the difficulties presented to research workers by this state of affairs, an informal meeting convened by Dr. M. Stephenson was held, under the chairmanship of Prof. T. Dalling of the Institute of Animal Pathology, Cambridge, at the Biochemical Laboratory in Cambridge on April 5, 1941, at which workers actively engaged in research in this field and those responsible for the production of antisera were present by invitation.

After a full discussion it was decided to adopt the following nomenclature as the basis for future publication.

(1) Among the antigenic substances found in filtrates the main toxic element is characterized by the following biological properties:

(*a*) It is lethal for mice when administered by intravenous injection.

(*b*) It produces a characteristic necrotic reaction on intradermal injection into guinea-pigs.

(*c*) It is hæmolytic *in vitro* for sheep red cells, the hæmolysin being oxygen-stable and requiring the presence of calcium ions for the full development of its action[2].

(*d*) It reacts specifically with normal human serum[3] and with egg-yolk solution to give a characteristic turbidity[2].

This reaction also requires the presence of calcium ions and is probably due to the action of a lecithinase which splits phosphocholine from lecithin[4].

These various reactions appear to be due to the action of one substance designated as the *alpha toxin* and they can be neutralized by alpha antitoxin.

The *alpha* toxin has long been recognized as the main element in the pathogenic action of *Cl. welchii* type *A*[5].

(2) A second hæmolysin has been recognized in *Cl. welchii* filtrates which has properties distinct from those of the *alpha* toxin :

(*a*) It exhibits a slight but irregular action when administered intravenously to mice, owing to the presence of natural antitoxin in this and other experimental animals.

(*b*) It produces a hæmorrhagic reaction, but it is not necrotic in action on intradermal injection into guinea-pigs.

(*c*) It is hæmolytic for sheep red cells *in vitro* ; the hæmolysin is reversibly oxidizable, the hæmolytic activity declining with the ageing of filtrates ; the hæmolysis is independent of the action of calcium ions.

(*d*) It does not give a reaction with human serum or egg yolk solution.

(*e*) It resembles closely streptolysin O.

(*f*) The reactions produced by this second hæmolysin are neutralized by high titre antihæmolysin O as well as by the homologous antiserum.

It was agreed that this second hæmolysin should be designated as *theta hæmolysin*, and that it should be clearly recognized as being distinct from *alpha* toxin of *Cl. welchii*.

The first mention of this type of hæmolysis is made by Neill[6] but no special nomenclature was adopted. Prigge erroneously called this hæmolysin *alpha*[7] and this mistake was repeated in the League of Nations Bulletin of the Health Organisation (8, 797 ; 1939).

The letter theta was first used as a designation for this hæmolysin in the literature by Macfarlane, Oakley and Anderson[2], and its properties have been clearly defined by Todd[8].

The use of zeta[7] for what is obviously the alpha toxin is therefore discarded according to the ordinary usages of nomenclature.

No assumption is made that these two elements are the only 'toxins' present in filtrates from all strains of *Cl. welchii*, type *A*.

[1] NATURE, **147**, 87 (1941).

[2] Macfarlane, Oakley and Anderson, *J. Path. and Bact.*, **52**, 99 (1941) ; van Heyningen, 1941, about to be published.

[3] Nagler, *Brit. J. Exp. Path.*, **20**, 473 (1939).

[4] Macfarlane and Knight, *Biochem. J.*, **35**, 884 (1941).

[5] Glenny, Barr, Llewellyn-Jones, Dalling and Ross, *J. Path. and Bact.*, **37**, 53 (1933).

[6] *J. Exp. Med.*, **44**, 199, 215, 217 (1926).

[7] *Z. Immunitätsforsch.*, **91**, 457 (1937).

[8] *Brit. J. Exp. Path.*, **22**, 172 (1941).

# RECENT WORK ON THE GEPHYREA*

DR. A. C. STEPHEN has published two memoirs relating to this group. He had a difficult task before him, for it is well known that its members are extremely elusive owing to their habitat and that the few specimens usually available are frequently damaged—a fact borne out by a species sometimes only being represented by an isolated introvert or flattened skin. It is therefore specially to be appreciated that so many specimens were brought up whole and undamaged and that colour notes made at the time of capture are available. The Discovery species are mainly from southern waters but some of the Sipunculids were secured in the Atlantic on the outward and homeward runs. Only one species is recorded in both reports—*Pyscosoma nigrescens* Keferstein, a widely distributed form in tropical waters, now obtained for the first time from Ascension and Tristan da Cunha. There are two new species from deep water from the Gulf of Oman and off the Maldive Islands, and one from the Gulf of Aden ; also one new species of Thalassema from the Antarctic. The most interesting records, however, are those relating to bipolar species.

It has been known for some time that there is a close similarity, amounting in many cases to specific identity, between arctic and antarctic species belonging to the Echiuridæ, Sipunculidæ and Priapulidæ, and this is further exemplified in the Discovery collections. Of the twenty-three species known from the Antarctic and here listed (a few obviously warm-water forms being excluded from the list) half are either northern species or very closely related to them and ten of these are identical with, or regarded as varieties of, arctic species, and two are very closely related to arctic forms but are still regarded as specifically distinct. In this list species collected by the British, Australian and New Zealand Antarctic Research Expedition are included, the report of which by the same author is now in the press. Of the ten which are identical with, or regarded as varieties of, arctic species, four are included in the Discovery Collections.

The author directs attention to the fact, which stands out and may represent a real condition, that in the Antarctic most of the bipolar species seem to be confined to the South American quadrant.

The known range of distribution in several cases has been considerably extended, thanks to the wide area over which investigations were conducted by the Discovery ships. The Echiurids especially are interesting. Only three species of this group were known from the Antarctic. Now three species are added, two of which, *Hamingia arctica* and *Thalassema faex*, are well-known species which have not so far been found in other than Northern seas, and the third is a new species, *Thalassema arcticum*.

Both monographs are illustrated by good photographs.

* The Echiuridæ, Sipunculidæ and Priapulidæ collected by the Ships of the Discovery Committee during the Years 1926 to 1937, by A. C. Stephen, D.Sc. Discovery Reports, Vol. 21, pp. 235–60, Plates VII, VIII. 1941. Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands (Cambridge University Press). Sipunculids and Echiurids of the John Murray Expedition to the Red Sea and Indian Ocean, 1933–34, by A. C. Stephen, D.Sc., John Murray Expedition, 1933–34. Scientific Reports, Vol. 7, No. 4, 1941. (British Museum (Natural History), London.)

# FORTHCOMING EVENTS

## Saturday, January 10

BRITISH INSTITUTION OF RADIO ENGINEERS (at the Federation of British Industries, 21 Tothill Street, London, S.W.1), at 3 p.m.—Dr. W. Wilson: "Recent Developments in the Design and Application of the Cathode Ray Oscillograph".

## Monday, January 12

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Discussion on "Geographical Aspects of Regional Planning".

## Wednesday, January 14

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. E. F. Armstrong, F.R.S.: "The Post-War Home—its Interior and Equipment". 3: "Materials, Old and New".

## Friday, January 16

ROYAL SOCIETY OF ARTS (INDIA AND BURMA SECTION) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Sir Bryce Burt: "Agricultural Progress in India during the Decade 1929–39".

## Saturday, January 10—Sunday, January 11

ASSOCIATION OF SCIENTIFIC WORKERS (at Caxton Hall, Westminster, London, S.W.1). Conference on "Science and the War Effort".

### Saturday

10 a.m.—Opening Address by Sir A. Daniel Hall, K.C.B., F.R.S.

10.30 a.m.—"University Training of Scientists". Dr. W. A. Wooster (Chairman), Prof. J. A. Carroll, Dr. V. E. Cosslett, Mr. R. R. Siday, Mr. D. G. Arnott.

10.30 a.m.—"Building, Housing and A.R.P." Mr. Ove N. Arup (Chairman), Dr. R. Fitzmaurice, Miss J. M. Blanco White.

2 p.m.—"Training of Technical Personnel". Mr. E. G. Savage (Chairman), Mr. J. A. Lauwerys, Dr. E. A. Rudge, Mr. D. A. Bell, Dr. B. E. Gilbey.

2 p.m.—"Food and Agriculture" (1st Session). Sir John Russell, F.R.S. (Chairman), Sir John Orr, F.R.S., Sir A. Daniel Hall, K.C.B., F.R.S., Dr. H. M. Sinclair, Prof. H. D. Kay, Prof. F. G. Gregory, Dr. A. Walton.

4.30 p.m.—"Food and Agriculture" (2nd Session). Discussion.

### Sunday

10 a.m.—"Utilisation of Scientific Personnel". Prof. S. Chapman, F.R.S. (Chairman), Prof. W. Wardlaw, Mr. E. D. Swann, Prof. H. Levy, F.R.S., Mr. D. P. Riley, Mr. F. M. H. Markham.

2 p.m.—"Application of Scientific Knowledge to Production and Services Problems". Prof. J. D. Bernal, F.R.S. (Chairman), Mr. T. Halse, Dr. P. Garland, Dr. K. Mendelssohn, Mr. J. W. Myers, Dr. J. Kuczynski, Mr. J. L. Pinder.

4.30 p.m.—Final Discussion. Mr. J. A. Henley, Prof. J. D. Bernal, F.R.S.

# APPOINTMENTS VACANT

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

DIETITIAN in charge of the Dietetic Department—The House Governor and Secretary, General Infirmary, Leeds (January 20).

LECTURER IN MECHANICAL ENGINEERING—The Principal, South-West Essex Technical College, Forest Road, Walthamstow, London, E.17.

EXECUTIVE ENGINEERS by the Nigerian Government Public Works Department—The Central Register (E.364), Ministry of Labour and National Service, Queen Anne's Chambers, Tothill Street, London, S.W.1.

ASSISTANT ENGINEER by the Sierra Leone Government Railway—The Central Register (E.365), Ministry of Labour and National Service, Queen Anne's Chambers, Tothill Street, London, S.W.1.

ENGINEER by the Sierra Leone Government Public Works Department—The Central Register (E.372), Ministry of Labour and National Service, Queen Anne's Chambers, Tothill Street, London, S.W.1.

PSYCHOLOGIST (man) at the Sutton L.C.C. Hospital, Sutton—The Medical Officer of Health (B), Mental Health Services, West Park Hospital, Epsom, Surrey.

PROFESSOR OF PHYSIOLOGY—The Secretary, University College, Cork.

# REPORTS and other PUBLICATIONS

*(not included in the monthly Books Supplement)*

## Great Britain and Ireland

Research Reports of the British Non-Ferrous Metals Research Association. Association Series No. 562: Researches on the Structure of Alloys. By Dr. W. Hume-Rothery. Pp. 20. (London: British Non-Ferrous Metals Research Association.) 2*s.* 6*d.* [1012

List of Fossil Plants found in the Coal-Bore made at Washing Bay, Co. Tyrone, in 1918; with Short Descriptions of New Species. Collected, identified and given to the National Museum of Ireland by Dr. T. Johnson. Pp. 13. (Dublin: National Museum.) [1212

University College of Wales, Aberystwyth: Welsh Plant Breeding Station. War Food Production Advisory Bulletin No. 6: Cereal Production. By E. T. Jones. Pp. 46. (Aberystwyth: Welsh Plant Breeding Station.) 1*s.* [1212

## Other Countries

Forest Bulletin No. 92: The Testing of Packing Cases for Army Boots and Suggested Improvements in their Design. By V. D. Limaye. Pp. iii+7+3 plates. 6 annas; 7*d.* Forest Bulletin No. 93: Indian Timbers for Tool Helves and Handles. By V. D. Limaye. Pp. iii+8+2 plates. 5 annas; 6*d.* (Delhi: Manager of Publications.) [412

Ceylon. Part 4: Education, Science and Art (D). Administration Report of the Acting Director of Agriculture for 1940. By E. Rodrigo. Pp. D18. (Colombo: Government Record Office.) 30 cents. [412

Records of the Geological Survey of India. Vol. 76, Bulletins of Economic Minerals No. 4: Phosphates. By M. S. Krishnan. Pp. 38+1 plate. (Calcutta: Geological Survey of India.) 12 annas; 1*s.* [512

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 41: Fertilizer Experiments on Sugarcane in India, 1932–39. By Dr. R. D. Edge. Pp. 64+1 plate. 3 rupees; 5*s.* Miscellaneous Bulletin No. 42: Fruit Pests of Baluchistan. By Nazeer Ahmed Janjua and C. K. Samuel. Pp. 42+3 plates. 2 rupees; 3*s.* (Delhi: Manager of Publications.) [512

Report of the Kodaikanal Observatory for the Year 1940. Pp. 4. (Delhi: Manager of Publications.) 2 annas; 3*d.* [512

Annual Report of the Agricultural Meteorology Section, India Meteorological Department, for the Year 1939–40. Pp. vi+38. (Simla: Government of India Press.) [512

Dominion of Canada. Report of the Department of Mines and Resources including Report of Soldier Settlement of Canada for the Fiscal Year ended March 31, 1941. Pp. 244. (Ottawa: King's Printer.) 50 cents. [1012

Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 7, No. 10: Radial Velocities and Spectral Line Intensities for Iota Herculis. By R. M. Petrie and William Petrie. Pp. 189–198. Vol. 7, No. 11: The Spectrographic Orbital Elements of H.D.23277. By R. M. Petrie. Pp. 199–204. (Victoria, B.C.: Dominion Astrophysical Observatory.) [1012

Nyasaland Protectorate: Geological Survey Department: Colonial Development. Water Supply Investigation Progress Report (No. 10) for the Year 1940. Pp. 8. (Zomba: Government Printer.) 1*s.* [1112

Annual Report of the Haffkine Institute for 1939. By Lt.-Col. S. S. Sokhey. Pp. iii+94. (Bombay: Government Printing and Stationery Office; London: High Commissioner for India.) 4 annas; 5*d.* [1212

Union of South Africa: Department of Agriculture and Forestry. Science Bulletin No. 232 (Chemistry Series No. 166): Dinitro-Ortho-Cresol and other Insecticides as Locust Poisons; Experiments of 1938–39. By M. C. A. Nolte. Pp. 55. 6*d.* Chemistry Series No. 167: Chrome Ores of the Western Bushveld Complex. By Dr. C. F. J. van der Walt. (Reprinted from "Transactions of the Geological Society of South Africa", Vol. 44, 1941.) Pp. 34. (Pretoria: Government Printing and Stationery Office.) [1612

Report of the Aeronautical Research Institute, Tokyô Imperial University. No. 212: The Coupling of the Propeller Blade Bending Vibration with the Crankshaft Twisting Vibration of a V Type Engine. By K. Tanaka and T. Ohino. Pp. 43. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 95 sen. [1612

Indian Central Jute Committee. Technological Research Memoir No. 3: The Moisture Regain of Jute at a Range of Atmospheric Humidities. By C. R. Nodder, K. R. Sen and B. K. Chakrabarti. Pp. 10. (Calcutta: Indian Central Jute Committee.) 1 rupee; 2*s.* [1612

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 45: Investigations on the Cold Storage of Potatoes. By Dr. D. V. Karmarkar and B. M. Joshi. Pp. 22. (Delhi: Manager of Publications.) 1 rupee; 1*s.* 6*d.* [1612

Report of the King Institute of Preventive Medicine, Guindy, for the Year ending 30th September 1940, by Lt.-Col. H. E. Shortt; and Report of the Government Analyst, Madras, by Herbert Hawley. Pp. 73+3. (Madras: Government Press.) 8 annas. [1612

Josiah Macy, Jr. Foundation. A Review by the President of Activities for the Four Years ended December 31, 1940, with Extracts from the Treasurer's Report for the Years 1937–1940. Pp. 125. (New York: Josiah Macy, Jr. Foundation.) [1612

Journal of the Indian Institute of Science. Vol. 23 A, Part 11: On a New Method of Synthesis of Phenanthrene Derivatives. By P. C. Guha and S. Krishnamurthy. Pp. 183–190. 12 annas. Vol. 23A, Part 12: Synthetical Experiments in the Camphane Series, Part 6: Synthesis of Homocamphoronic Acid. By P. C. Guha, K. S. Subramaniam and V. R. Srinivasan. Pp. 191–200. 14 annas. Vol. 23A, Part 13: On Utilisation of Indian Turpentine Oils. Part 1: The Constituents of Turpentine Oil from *Pinus longifolia* Roxb., *Pinus excelsa*, *Pinus khasya* and *Pinus merkussi*; Part 2: Conversion of *α*- and *β*- Pinenes into Bornyl Acetate by Acetic Acid in Presence of Catalysts; Part 3 (i) Catalytic Isomerisation of *α*- Pinene and *β*- Pinene to Camphene, (ii) Synthesis of Camphor from Pinene-Camphene Misture. By P. C. Guha and Arunendra Narayan Roy. Pp. 201–226. 1.12 rupees. Vol. 23A, Part 14: Activation and Clarifying Properties of Fuller's Earth, Part 7: Activation of Fuller's Earth. By B. S. Kulkarni and S. K. K. Jatkar. Pp. 227–236. 12 annas. (Bangalore: Indian Institute of Science.) [1612

Annual Report of the Public Health Commissioner with the Government of India for 1940. Pp. vi+110. (Delhi: Manager of Publications.) 12 annas; 1*s.* [1612

Bulletin of the American Museum of Natural History. Vol. 78, Art. 6: The Morphological and Functional Evolution of the Tarsus in Amphibians and Reptiles. By Bobb Schaeffer. Pp. 395–472. Vol. 78, Art. 7: On a Collection of Millipedes and Centipedes from North-eastern Peru. By Ralph V. Chamberlin. Pp. 473–536. (New York: American Museum of Natural History.) [1612