NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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NATURE

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COLONIAL DEVELOPMENT AND MAN-POWER PROBLEMS

IT has often been remarked that debates on Colonial affairs attract but little attention within or outside Parliament, and the debate in the House of Commons on July 9 was no exception. Following on, however, the issue of two Colonial Office Papers on the Organisation of the Colonial Service and on Post-War Training for the Colonial Service, this debate, in which the Secretary of State for the Colonies made the first peace-time statement of Colonial policy, touches on a number of points of considerable direct and indirect interest to the scientific worker as such. On the broad trend of policy, Mr. George Hall stated that it is the Government's policy to develop the Colonies and their resources so as to enable their peoples speedily and substantially to improve their economic and social conditions, and, as soon as may be practicable, to attain responsible self-government ; and he showed that there is no intention of breaking with the policy pursued by the Coalition Government since the Colonial Development and Welfare Act of 1940. Similarly, on matters of detail it appears that more vigorous prosecution of a similar policy under the more favourable conditions of peace-time is contemplated, rather than any radical innovation or reversal of trends.

This is notably true in the field of international co-operation, where, after referring to the agreement of the French and Netherlands Governments to enter the Anglo-Caribbean Commission as full members, Mr. Hall remarked that the Commission has already arranged for co-operation in research and that the Caribbean Research Council had been set up. The last West Indian Conference had already recommended that an international secretariat should be established in the Caribbean area as soon as possible to serve both the Conference and the Commission. Further, it has been decided to call an early conference to set up a regional organisation in the South Pacific for the purpose of exchanging views and information on technical and economic subjects, and a series of conferences have already been held with representatives of the French Ministry of Overseas France and with representatives of the Belgian Colonial Office. Britain has also agreed to share experiences on training for the Colonial Service, and it is hoped to exchange officers in training.

It is proposed, Mr. Hall said, to start in the summer of next year by sending a selected number of officers in training for the British Colonial Administrative Service to Paris for a special course at the National School of France Overseas, while some of the French students in training will come to England to attend part of the course at Oxford for British Colonial administrative trainees. Mr. Hall attaches much importance to this kind of international co-operation, and it should undoubtedly considerably help the development of regional co-operation in research and in other fields. It is indeed by regional co-operation that we must look for the establishment in overseas

territories of research institutes of sufficient standing and resources to make contributions in most branches of science comparable with those made in the metropolitan country. In certain branches of applied science, the natural location of a research institute may, of course, be in a particular area where a special problem or group of problems is endemic. Ordinarily, however, Colonial territories, even with a regional basis, will rarely possess the resources which can compensate for the drawbacks, such as isolation from the main body of men of science, attendant upon scientific research overseas.

Mr. Hall, in the course of his statement, showed clearly that the Government attaches great importance to research in its policy of encouraging the social and economic progress on which political development depends. Research projects figure prominently among the central schemes for Colonial development, and the past year has seen both the completion of the main structure of the research organisation and a rapid growth in the number of research schemes started. In all, fifty-four new research schemes were approved in the year 1945–46, and the fruit of the years of planning and survey under the wise guidance and leadership of Lord Hailey, as chairman of the Colonial Research Committee, is now beginning to appear as more scientific personnel are released from war work. Mr. Hall said he recognizes the danger that planning of research may get out of touch with the practical problems of the people of the Colonies, and in this connexion visits such as those of the Director of the Colonial Products Research Council to the West Indies, of the Secretary of the Social Science Research Council to West Africa, and of Sir Frank Engledow, Prof. J. W. Munro and the Agricultural Adviser to the Colonial Office to East Africa are important. More attention might well have been given to this question by the Empire Scientific Conference.

There are two aspects of research on Colonial problems which deserve special attention at the present moment: international collaboration and man-power. It is not merely in the training of administrators for the Colonial service that co-operation is important. An article by R. Combes on "Scientific Research in the Colonies" in a recent issue of the *Revue générale des Sciences pures et appliquées* (53, 2 (1); 1946) reviews the defects of the present French system of training, and outlines courses intended to improve the quality of recruits for scientific research in the Colonies, the first year of which will be taken in France and the second in the Colony in which the recruit is to work. These courses are intended for the scientific recruit only and are thus more limited in scope than the proposals of the Devonshire Committee and in Sir Ralph Furse's memorandum recently discussed in *Nature* (158, 73; 1946). Taken with the creation on the Ivory Coast of an Institute of Intercolonial Teaching and Research, the extension of the French Institute of Africa at Dakar, the formation of an Institute of Central African Studies in equatorial Africa, the re-organisation of scientific work in Madagascar and the creation of a French Institute of Oceania in New Caledonia, they indicate the great importance which France already attaches to scientific research in her Colonial territories.

Moreover, it will be remembered that France has already decided to follow the British example and to transfer her mandated territories in West Africa to trusteeship under the United Nations. It may be taken for granted, therefore, that the further projects for the re-organisation and development of scientific research in the Cameroons and Antilles at least, if not in Indo-China also, which are at present under examination by the French Government, will not be worked out entirely in isolation or without reference to such bodies as the Caribbean Research Council. Regional collaboration, as already indicated, affords the best prospect of establishing research institutes sufficiently equipped and endowed to attract men of the requisite quality in sufficient numbers for really effective work.

It should also be noted that the Royal Society Empire Scientific Conference recorded its view that there is a growing need for the development of long-term fundamental research dealing with African problems on a regional, as distinct from a territorial, basis, and to meet this need it recommended the formation of a Commonwealth African Research Committee. The terms of reference for this Committee include the examination and furthering of proposals for centralizing fundamental research in African problems on a regional basis; the planning ahead of such developments so as to ensure the necessary financial support and the training of the specialist staffs required; and advising the governments concerned through the appropriate authorities on matters of regional development and co-operation in fundamental research. With the reservation that the bulk of fundamental research may for some years continue to be done in Great Britain, there can be little doubt as to the soundness of this proposal. It might, in fact, be suggested that it scarcely goes far enough, and that something on the lines of the Caribbean Research Council or the Middle East Supply Centre is more what is required as regards the extent of co-operation.

Much the same condition applies to university work in the Colonial territories in general, and in the House of Commons debate Mr. Oliver Stanley, like Mr. Hall, indicated his preference for development on the lines recommended in the minority report of the Elliott Commission for precisely such reasons. Mr. Hall said that he has now proposed the establishment of a university college for West Africa in Nigeria, where facilities for students in agriculture, forestry and animal health already exist, which would include a wide range of studies in arts and science, build up research and maintain a suitable standard of admission. While the research school would be established there, each of the three territories should broaden its secondary work so as to increase the number of students who could work to intermediate level and beyond and to further technical education.

Mr. Hall is convinced that West Africa needs a first-class university in fact and not merely in name, and with the shortage of available staff and supplies,

a wide range of arts and science studies in more than one territory is scarcely practicable. This was the main reason why Colonel Stanley regarded with some misgivings the suggestions regarding Fourah Bay College and Achimota College to which Mr. Hall referred. One unitary university is the realistic policy in view of the difficulty of obtaining adequate teaching staff from Great Britain and of obtaining really adequate material. The demand for a second university might well prove fatal to the establishment of the one good university which is possible.

The expansion of research in the Colonial territories and the development of the Colonial universities has to be set against this prime problem of man-power, and the shortage of scientific man-power in particular to which the report of the Barlow Committee directed attention. That expansion and development cannot proceed in the immediate future without regard to the position in Great Britain is clear; for they must for some time to come draw heavily on British man-power resources, however much of the basic research, such as that on which agricultural science depends, is prosecuted in Britain. The discussions at the Royal Society Empire Scientific Conference and the recommendations which were the outcome of that Conference give some indication how serious that demand may well prove, and some of the directions in which a particular shortage of scientific workers may be felt; for example, in such fields as taxonomy, genetics and microbiology. More specifically, in considering post-war needs in fundamental research, the Conference, recognizing the great increase in the number of scientific workers which would be required, considered that it is important that plans for extending fundamental research in any field should be supported by measures designed to increase the number of trained workers able to carry out such plans.

One point which stands out in all the recent papers dealing with aspects of Colonial development, such as training for the Colonial Service, research, or the organisation of the Colonial Service, education and other matters, is this question of man-power. The paper on the Organisation of the Colonial Service*, for example, refers to the need for recruitment of candidates from the United Kingdom and the Dominions on a very considerable scale for a wide variety of posts. The Asquith Commission and the Elliot Commission both recognized that the Colonies will require large numbers of well-trained teachers, medical men, scientific workers, agriculturists, administrators and research workers; and that while these would for the most part have to be trained in Africa or other Colonial territories, the expansion of the Colonial universities to meet that need could only take place with the help of the universities of Great Britain. Reports of the Colonial Research Committee bear similar witness to the dearth of research workers and to the competition with Britain which inevitably arises for the services of such men and women both in the natural and in the social sciences.

* Organisation of the Colonial Service. (Colonial No. 197.) Pp. 12. (London: H.M. Stationery Office, 1946.) 2*d*. net.

Major G. St. J. Orde Browne's report on Labour Conditions in East Africa* similarly points to the need for more trained man-power in the labour departments.

These demands for man-power have, moreover, to be set against the situation in Britain reviewed in the report of the Committee on Scientific Man-power. Since that Committee reported, the findings of the Committee on the Provision for Social and Economic Research have emphasized that the universities of Britain are already under-staffed and under-endowed for that purpose, that provision for research in this field is seriously inadequate and that the supply of qualified staff both for teaching and for the increasing needs of study and research is far short of the level which current conditions and political trends demand. The National Institute of Economic and Social Research, in its last annual report, directed attention to the way in which its research policy is restricted by the severe shortage of trained applied economists, and both the 'working parties' appointed by the President of the Board of Trade which have so far reported have stressed the need for the employment in industry of more scientific workers and trained administrators.

It is already well known that the post-war development plans of a number of industrial firms involve the recruitment of many more trained scientific men than the universities are at present able to supply, and this increased demand competes with the demands for more teachers and for more trained workers for the research associations and for other Government departments. For such reasons it is desirable that the Committee on Scientific Man-power should continue its work and formulate further proposals, as well as a closer analysis of demand, so as to facilitate continual re-assessment of priorities and to increase the efficiency with which the services of trained man-power are utilized. Allocation of man-power may be too complicated to attempt except within the broadest limits, but at least something more could be done to ensure that the best possible use is made of the trained man-power of Great Britain wherever it is employed.

The increasing demand which the programme of nationalization to which the Government is committed may make upon such man-power renders it the more imperative for the Government to set an example in its efficient use. That is one urgent reason for reviewing the whole experience of the research associations, as suggested by the Working Party for the Cotton Industry, and the use of trained man-power in the Colonial Service can be no exception. Furthermore, the recent report from the Select Committee on Estimates regarding the Control Office for Germany and Austria cannot but arouse grave doubts as to whether other departments also are making the most economical use of trained service at their disposal. The causes of superfluity of staff to which this report directs attention are in the main peculiar to the Control Commission, but

* Colonial Office. Labour Conditions in East Africa. Report by Major G. St. J. Orde Browne. (Colonial No. 193.) Pp. ii +94. (London: H.M. Stationery Office, 1946.) 2*s*. net.

the observations of the Committee in regard to quality of staff are not without their bearing on recruitment to the Colonial Service. "The quality of a staff," the Select Committee observes, "ultimately depends, to a very large extent, on their conditions of service. . . . Young, efficient men and women, imbued with proper tradition of service and fired with the moral purpose required, cannot be obtained if their future is to be jeopardised by uncertainty as to their ultimate position." These observations may well apply to the recruitment of staff for scientific research overseas, especially where what is required is research in the field from a Colonial institution for a relatively short term of years. Not merely careful selection of actual staff, but also attention to such matters as superannuation and pension schemes, leave and travel allowances, to which the Empire Scientific Conference also paid marked attention, are important; and a survey of such Colonial Services by the Organisation and Methods Division of the Treasury with the view of closer integration might well be as valuable here as recommended by the Select Committee for the Control Commission.

The most impressive fact which emerges from the Select Committee's review of the Control Commission's staff, however, is that the job the Commission has to do in Germany could be done—and probably done better—by a much smaller staff than the 22,500 people at present employed. Reliable estimates suggest that between 10,000 and 11,000 British men and women of the right type and attracted by terms of service such as the Select Committee suggests would suffice. On that basis we are largely wasting the work of some 11,000 British people, a considerable proportion of whom represent trained man-power. To set that estimate against the figures given in the Barlow Committee's report sufficiently demonstrates the seriousness of this waste, and the importance of taking every possible step to see that, both in Great Britain and in the Colonial Service overseas, the best possible use is made of the limited resources of trained man-power and woman-power.

The Colonial Paper (No. 197) on the Organisation of the Colonial Service gives the clearest picture of what is involved and of the extent to which a Colonial revolution is already in process as Great Britain addresses itself to the tasks to which it is committed by the Colonial Development and Welfare Act no less than by the whole trend of world opinion which has brought the trusteeship system into being. The plan of action set forth in this White Paper is intended to meet three main requirements: the large reinforcements needed by the Colonial Service; the full equipment of such reinforcements for their task; and the adaptation of the structure of the Colonial Service to modern conditions. Such a service must now provide "a framework in which the right man or woman can be put in the right place, irrespective of race or colour; in which there is equality of treatment and opportunity for all on the basis of merit and efficiency; in which the 'passenger' can be disposed of without undue hardship; in which the poorer Colonies stand the best possible chance of getting the staff which they need".

These requirements can be met only by co-operation between the Government of the United Kingdom and the Colonial Governments, legislatures and people. The White Paper indicates that the Government of the United Kingdom will play its full part in the first instance by contributing to the cost and providing opportunities for increasing the supply of qualified Colonial candidates for posts in their own services. A sum of £1,000,000 has already been allocated under the Colonial Development and Welfare Act over the next ten years to enable selected Colonial candidates to receive professional and vocational training which would qualify them for appointment to the higher grades of the Colonial Service. The Government will also assist in the recruitment of qualified staffs as may be necessary in the United Kingdom, and with the co-operation of the university authorities a plan has been worked out by which, as indicated in the Devonshire Report, the main business of post-selection training for the Colonial Service will be carried out for the present in the Universities of Oxford, Cambridge and London, with substantial financial assistance under the Colonial Development and Welfare Act. The idea of setting up a staff college for the Colonial Service has been rejected, after very full consideration, in favour of this plan of using the universities, which will provide opportunities for study before and after a period of Colonial experience; for this post-selection training a further sum of £1,500,000 will be provided under the Act.

To enable the Colonies to secure the services of expert staff which they could not otherwise afford, further *ad hoc* grants may be made, and the White Paper outlines further proposals regarding the structure of the Colonial Service designed to co-ordinate the distribution of staff so that the available resources are disposed to the best advantages of the Colonies as a whole. To this end a number of principles are set out which should be regarded as objectives for the various Colonial Governments in framing their individual schemes. The salaries of all posts in the public service of a Colony, it is suggested, should be determined according to the nature of the work and the relative responsibilities, irrespective of the race or domicile of the individuals occupying the post; they should be fixed at rates applicable to locally recruited staff, having regard to relevant local circumstances. Expatriation pay should be provided where such basic salaries are insufficient to attract and retain officers from overseas, but the practice of providing free quarters for certain classes of officers should be discontinued. Home-leave at regular intervals and free, or at least assisted, passages for themselves and their families on all necessary travelling occasions should be provided for officers whose homes are not in the Colony in which they serve. Besides recommending a review of serving conditions generally, the White Paper recommends that to ensure that the standard of qualification for the higher posts is maintained, and that the resources of the Service as a whole are utilized to the best advantage in the general interest, the Secretary of State should continue to control appointments to the higher admin-

istrative and professional posts in the Colonial Service, but public service commissions should also be established in the Colonies.

Besides this, it is proposed to provide a central directorate in each group of the biological research services (medical, agricultural, veterinary and fisheries) to advise the Secretary of State as to the programme of research and arrange for its execution in the Colonies and elsewhere. In the non-biological sciences, comprising the survey, geological survey and meteorological branches, which transcend Colonial and even regional boundaries, the central services will be handled as teams of experts directed from the centre according to the needs of the moment, and provision will be made for Colonial Governments to have at their disposal members of the team. Apart from these central services, it is also proposed to develop regional arrangements for the pooling of staff by neighbouring Colonies where suitable conditions for such development exist.

One difficulty in securing the desired flexibility and interchange of staff is the absence of any pension scheme for the Colonial Service as such. The White Paper recognizes the difficulties in the way of a uniform scheme, but emphasizes the desirability of reviewing the main features of the existing Colonial pension laws with the view of securing that the superannuation arrangements are best calculated to contribute to the efficiency of the public service. Several Colonial Governments will be requested to take this action, and admirable principles are laid down for their guidance in the White Paper, which points out that there will still be required a centrally organised scheme to cover expatriate officers serving in Colonies which have no local scheme. Proposals will be submitted to the governments of such Colonies, and in addition a plan is being worked out for establishing a central scheme on the lines of the Federated Superannuation System for Universities to meet the needs of research workers and technical officers in the central services or seconded for limited periods for special work.

It will be clear from this brief summary that these proposals represent a constructive reform long overdue, and fraught with the highest possibilities not merely for Colonial development but also for the more efficient use of trained man-power in that work both in Great Britain and overseas. If, however, the proposals and the schemes which result from them are to have their full effect, scientific workers must make a most important contribution. The weaknesses in the Control Commission of Germany to which the Select Committee directed attention are due largely to the failure to formulate a firm long-term policy either for the whole of Germany or for the British Zone; similarly, no re-organisation of the Colonial Service or development or welfare schemes can be a substitute for clearly defined and firmly pursued policy. Research schemes may prove wasteful and ineffective, for example, unless at the start there are clear conceptions as to the extent to which fundamental research can fruitfully be pursued overseas and the availability of the resources required in such work.

The proposals outlined in these White Papers and by the Secretary of State for the Colonies therefore will require close and continual scrutiny if they are to achieve their purpose. Research programmes must be examined in relation to conditions in Great Britain and overseas to determine where they can be most efficiently pursued; some balance must be maintained between the long-range or fundamental investigations and the short-term objectives. The disposition of staff as between overseas and the United Kingdom and its distribution between research and teaching, between Government service and industry will require constant examination in order to make the best use of our limited resources of man-power. Much of that scrutiny is the affair of scientific workers themselves, and no external administrative reforms or re-organisations can relieve them of that responsibility. In order that the Colonial Development and Welfare Act is to achieve its full purpose and the Colonial revolution it has initiated is to bring its full benefit to the Colonial peoples—and indeed to the people of Great Britain also—scientific workers must realize the greatness of the opportunity that lies before them and respond to the call with all the energy, imagination and vision that they can bring to bear. Continuous informed and constructive criticism as well as moral leadership are the responsibility of the Colonial powers and the condition for realizing the hopes of the new trusteeship system to which in the United Nations Organisation they are already committed.

METHOD IN CHILD PSYCHOLOGY

Psychology of Infancy and Early Childhood

By Prof. Ada Hart Arlitt. (McGraw-Hill Home Economics Series.) Third edition. Pp. xiii + 475. (New York and London: McGraw-Hill Book Co., Inc., 1946.) 19*s*.

DR. ARLITT'S book was first published in 1928. This third edition takes account of many researches since that date. It provides a useful summary and discussion of recent work on such topics as the innate equipment of the infant, reflexes and random activities, habit, perceptual learning and memory. It is, however, a very uneven book and on certain matters, such as emotional and sexual development, it shares the muddled thinking apparent in many American and some English text-books. The general bias is 'behaviouristic' in the narrow Watsonian sense. There is so little understanding of psychical functions as such that it is doubtful whether the book is rightly entitled "Child Psychology".

To me, its main interest lies in its methodology. The author not only tends to think of complex mental processes mainly in 'behaviouristic' terms, but also jumps about from physiological to psychological modes of expression, and back again, without apparently realizing that she is doing so.

If the poet asks:

> "Tell me where is fancy bred
> Or in the heart or in the head?
> How begot, how nourished?
> Reply, reply."

Dr. Arlitt answers: "Love" (as distinct from lust) "is a series of coordinated reflexes controlled largely by the cranial division of the autonomic nervous system plus the perception of these changes together with the ideational content and the stimulus in response to which both appeared". Is anyone really the wiser for this hybrid definition?

Not only are the emotions treated as essentially non-psychical: they are also greatly over-simplified. "When the individual is in love, if it be love and not excitement, he is in an excellent physiological state. Digestion is at its best, the salivary flow is normal, the peristaltic contractions are balanced, neither too rapid nor too slow." This is contrasted with the effects of the "sex drive" (the two being kept quite apart until adolescence). ". . . an individual driven by the appetitive sex drive may find a large number of physiological changes not of a pleasant nature. The general tone may be excited and there may be a rapid shift from the sacral to the central division of the autonomic nervous system, in which case anger, fear and excitement may alternate with the sex drive."

But Freud's work (to which, curiously enough, the author pays a limited tribute in her first chapter and at other places) has shown that 'love' and the 'sex drive' cannot be considered in this sharp separation and contrast. In any event, love is a highly complex state of mind—as the poets have always known. Whether or not it is directed to a consciously sexual object, love commonly carries with it, as well as tenderness, joy and satisfaction, some measure of self-doubt, anxiety, insufficiency, incipient grief and dread of loss: "infinite passion and the pain of finite hearts that yearn".

The inadequacy of the author's account of human emotions is not made up for by the fragmentary 'behaviouristic' physiology in terms of which she attempts to deal with human experience.

Moreover, when questions arise which tend to stir affective responses in all who investigate them, objectivity goes to the winds. Dr. Arlitt swings naively between dogmatic denials of certain facts and practical warnings to parents as to how to *prevent* these denied phenomena. She says, for example, that the period between three and five years of age is "a neutral period in which there appears to be very little interest in sex and in which the side of the sex instinct which is stimulated is largely psychic"—a view which is in flat contradiction to that of most close observers of the behaviour of young children at this age. She holds that questions asked at this period such as, Where do babies come from? "can be interpreted as interest in sex but are probably more truly classified as a phase in the development of language". In the same way she writes: "Body play of a sex type often starts during this period. It should be kept clearly in mind that such activity may, and often does start merely as body play on a level with playing with arms, fingers, toes and the like." (At three to five years, be it noted!) Yet she gives elaborate instructions as to how to avoid the setting up of "bad sex habits". Now if playing with the genital were "on a level" with playing with arms, fingers, toes, etc., why should it be regarded as a "bad sex habit"? And why should such precautions to avoid it as are given on p. 153 be required? The author says: "If masturbation has been developed through carelessness, all the above cautions should be observed, but the child should on no account be made conscious of the fact that the habit is a serious one"!

Evidently one may also read 'the psychologist' for 'the child'. I am reminded of an English educator who said to me, of a mass of evidence showing the frequency of neurotic disturbances in early childhood: "I think your picture is greatly exaggerated. Of course my own children had these troubles, but naturally I took no notice of them."

Experience has long shown how difficult it is to keep the scientific and the didactic points of view apart, and how hardly come by is objectivity, in these fields of inquiry.

SUSAN ISAACS

SCIENCE, PHILOSOPHY AND SOCIETY

Problems of Men

By John Dewey. Pp. viii + 424. (New York: Philosophical Library, Inc., 1946.) 5 dollars.

PROF. DEWEY'S new book contains some thirty essays, collected with one exception from periodicals published in the last dozen years. They fall into four sections, entitled "Democracy and Education"; "Human Nature and Scholarship"; "Value and Thought"; and "About Thinkers". Many of the essays in the two earlier sections seem to have been addressed to unprofessional readers; others, in the later sections particularly, contain replies to published criticisms of views which the writer has expounded at length elsewhere. Their collection in a somewhat bulky volume gives a perhaps unavoidable impression of repetition and diffuseness.

To an English reader, Prof. Dewey seems to be at his best in his critical appreciations of the work of other writers. The last section contains essays on James Marsh—a New England scholar who did much to acclimatize Kantian and post-Kantian philosophy in the United States, early in the last century—William James and Whitehead, which are clearly written, sympathetic and illuminating. They are markedly free from a somewhat partisan tone which appears now and then in Prof. Dewey's more popular discussions of current topics. In these passages Prof. Dewey is evidently occupied with contemporary controversies in the United States about the aims of education. His references are often vague; the reader is sometimes left in doubt as to what man, place or century is under review, and just what opponents the writer is combating. (Possibly, of course, an English reader misses allusions which would be obvious on the other side of the Atlantic.) There are evidently schools of thought which hold that higher education in the United States has become too vocational, and is preoccupied with means and techniques at the expense of neglecting ends. Their remedy would be to restore the prestige of strictly non-vocational literary, historical and philosophical studies. Others, again, would reinstate Christian teaching as the foundation of all studies. In opposition to such views as these, Prof. Dewey would insist that scientific methods can be applied to all human affairs; and that such methods do not allow us to assume that there is any repository of wisdom handed down from earlier generations. Prof. Dewey agrees with the traditionalist critics of contemporary education in holding that "the present system . . . is so lacking in unity of aim, material,

and method as to be something of a patchwork", while differing from them radically in his diagnosis and prescriptions. He would ascribe the dispersion of intellectual effort to which he refers, not to preoccupation with the modern technological revolution but to a too timid acceptance of it. Behind those who diagnose neglect of ancient verities he seems to catch a glimpse of the spectres of the inquisitor and the censor.

"Scientific" methods are just as relevant to the traditional problems of philosophy and ethics as they are to practical affairs. In view of Prof. Dewey's stress on this point, it is a little surprising to find that he never refers to the mass of precise and detailed work which has been done in recent years by those who, under the style of "logical positivism" or "logical empiricism", have held out similar hopes of a new scientific method of philosophizing. Prof. Dewey adopts from Lord Russell an important distinction between the "scientific temper" and "scientific techniques". The scientific temper is "cautious, tentative, and piecemeal". But the popular prestige of science is largely due to the spectacular practical effects of scientific techniques; and command of these techniques may produce a sense of "limitless power" and "arrogant certainty" in those whose scientific education has been inadequate. It is the scientific temper, not the popular caricature of it, that Prof. Dewey would have us cultivate.

In the third, the most technical section of his book, Prof. Dewey raises a number of questions on ethics and the theory of knowledge which are of great interest to contemporary philosophers, in a style which unfortunately sometimes becomes impenetrably obscure. Instances may be found in the longest of the essays, on "Logical Conditions of a Scientific Treatment of Morality", apparently written half a century ago. The writer tells us that "by 'scientific' is meant methods of control of formation of judgments", and that "control of moral judgment requires ability to constitute the reciprocal determination of activity and content into an 'object' ". The context does little to lessen the ambiguity of such words as 'control' and 'determine'. "The two marks of scientific procedure", Prof. Dewey writes, "are the determination of *validity* [of a judgment] by reference to possibility of making other judgments upon which the one in question depends, and the determination of *meaning* by reference to the necessity of making other statements to which the one in question entitles us". More simply, we are proceeding scientifically when our judgments, or statements, rest on grounds, and when their meaning can be ascertained by considering what conclusions we can draw from them. This is to use 'science' in a very wide sense. Nevertheless, if ethics is to be scientific in this sense, some possible theories, particularly those commonly called intuitionistic, are excluded.

Prof. Dewey would perhaps go further, and hold that we are not being scientific unless *every* judgment we make rests upon others—or at least is subject to "a critical or inquiring and testing attitude". In that event, the limits he is setting to ethics are still narrower, since he is excluding all theories which allow any self-evident ethical propositions. Thus, in particular, he is excluding not only intuitionistic theories about moral judgments relating to individual situations, but also theories which make those judgments deductions from self-evident general moral principles, in conjunction with the facts of the case.

In a later paper, Prof. Dewey's denial of self-evidence is linked with the claim that "the test and mark of truth" is to be found "in *consequences* of some sort". What appeared as the criterion of meaning in the earlier paper seems now to have become the criterion of truth. The two treatments are reconcilable. But it is difficult to see how Prof. Dewey's 'fallibilism', to use a term he adopts from Peirce, is to escape the well-known objections to the coherence theory. Prof. Dewey claims to hold, in some sense, a 'correspondence', and not a coherence theory of truth; but in just what sense is not very clear. In spite of these difficulties, those who share the writer's empiricist preconceptions will sympathize with his wish to save fallibilism. They will feel in their bones that every empirical judgment must, in some sense or other, be corrigible in the light of further experience, and that in resisting Lord Russell's recent defence of the incorrigible basic proposition Prof. Dewey must be on the right track.

Prof. Dewey's essays contain a number of discernin *obiter dicta* on the history of philosophy, and are marked throughout by resolution to press principles to their conclusions and to face all difficulties.

The proof reading is not above reproach, and the index might be more comprehensive.

THE TOOLS OF PROTEIN RESEARCH

Advances in Protein Chemistry
Edited by M. L. Anson and John T. Edsall. Vol. 2. Pp. xiii + 443. (New York: Academic Press, Inc., 1945.) 6.50 dollars.

THE structure of proteins is probably the most important and possibly the most difficult of the major unsolved problems of chemistry, at least for the immediate future, and coming at a time when preparations are being made in numerous places to storm this citadel, the present volume is very timely since it gives clear reviews of many of the new methods which will be employed. It reflects the present trend of protein research towards exact analysis and what one might call the 'classical' organic approach to the problem. The X-ray method has clear possibilities, but they are more limited and at the same time involve greater difficulties than was originally expected. In his excellent survey of this field, I. Fankuchen sums up the position with regard to crystalline proteins as follows. "Single protein crystals can be made to yield exceedingly detailed X-ray diagrams and yet one must admit that to date the results of such single crystal studies have been disappointing; disappointing because very beautiful and complete data have so far only yielded comparatively meagre results"—a conclusion which broadly coincides with the views expressed in the discussion at the Roentgen celebration in London. It appears that although we can expect definite information about the number and arrangement of protein molecules in the unit cell, a complete structure analysis lies in the distant future; perhaps not a surprising situation when one contemplates the empirical formula recently given by Brand and his co-workers for lactoglobulin, one of the few cases in which the analyses approach finality, namely, C_{1864} H_{3012} N_{468} S_{21} O_{576}, or particularizing the amino-

acids by easily recognisable abbreviations, as follows: Gly_8 Ala_{29} Val_{21} Leu_{50} $Ileu_{27}$ Pro_{15} Phe_9 $CySH_4$ $(CyS)_8$ Met_9 Try_4 Arg_7 His_4 Lys_{33} Asp_{36} Glu_{24} $(Glu\text{-}NH_2)_{32}$ Ser_{20} Thr_{21} Tyr_9 H_2O_4! It might perhaps not unfairly be said that the chief contribution of the X-ray studies has been to demand and stimulate more accurate analyses.

With this vital question of analyses the earlier articles in the present volume are mainly concerned. The international character of the series is worthily maintained by an article on the analytical chemistry of proteins by A. J. P. Martin and R. L. M. Synge, the comprehensiveness of which can be judged from the fact that no less than 771 references to the literature are quoted. An excellent account is given not only of the straightforward chemical methods, but the newer techniques of chromatography as developed by the authors themselves (partition chromatography), by Tiselius (front analysis) and by Wieland, Turba, Block and others.

Complementary to this is an article on the microbiological assay of amino-acids by E. E. Snell. These methods equal the accuracy of the best chemical methods and seem likely to displace them for routine tests now that a considerable variety of suitable organisms is available. This article is appropriately followed by a discussion by R. J. Block of the amino-acid composition of food proteins.

S. W. Fox discusses the identification of the terminal amino-acids of peptides and proteins—perhaps the Achilles' heel of protein research, since if the terminal groups are removed one after another, or if the chain is broken in a suitable number of places and the terminal groups identified, the complete order of the amino-acids can be arrived at in time. It is a little unfortunate that the greatest successes of this method so far, the identification of the terminal groups of insulin by Sanger and the elucidation of the order of the amino-acids in the peptide gramicidin by Synge, should have been published too late to be quoted.

The remainder of the volume is made up of a rather miscellaneous collection of articles on various topics, and the writer cannot do more than indicate their subjects. P. R. Cannon discusses antibody formation from the point of view of the amino-acid requirements involved. C. R. Dawson and M. F. Mallette give a detailed account of the copper proteins, the most interesting examples being the hæmocyanins which function in the blood of invertebrates such as crabs, snails, lobsters, etc., in much the same way as the iron protein, hæmoglobin, in the blood of animals. K. Meyer gives an account of mucoids and glycoproteins, a field which he defines as that of natural substances containing hexosamine. The proteins of this group contain such diverse and interesting substances as the gonadotropic hormones, serum albumen and globulin and egg albumen.

M. J. Blish describes the proteins of wheat gluten, their composition and properties—a matter of profound importance at a time when the most economical utilization of the wheat grain is of urgent interest to a large part of mankind. Within a few days of the start of bread rationing it is strange to read that "until recently wheat was regarded as one of the more serious *surplus commodity* problems", a fact which stimulated inquiry into possible non-food industrial utilizations of the wheat protein!

The remaining articles cover ground, some part of which has been reviewed in other publications not long ago. D. French and J. T. Edsall discuss at considerable length the reactions of formaldehyde with amino-acids and proteins. M. L. Anson gives a clear and detailed picture of the difficult and complicated subject of protein denaturation.

If the editors go on like this, we shall soon have an extensive and up-to-date reference library on proteins. The two volumes which have come out have been in almost continuous use in the writer's laboratory. References to articles which are to be printed in vol. 3 have already been noted and its appearance will be awaited with impatience.

J. A. V. Butler

PROGRESS IN INDUSTRIAL RESEARCH

Industrial Research and Development in the United Kingdom

A Survey. By Sir H. Frank Heath and A. L. Hetherington. Pp. xiii + 375 + 23 plates. (London: Faber and Faber, Ltd., 1946.) 25*s*. net.

THIS comprehensive survey is written for the layman by two authors dubbing themselves as non-experts, but who had in its earlier days much administrative experience in the then newly formed Department of Scientific and Industrial Research. With the aid of numerous experts they trace the growth on the technical side of the major sections of British industry and very briefly describe the efforts made by co-operative research to assist many of them.

The miscalculation on the part of the Department of Scientific and Industrial Research of the time required to establish the research association movement as an essential part of British industry is freely admitted. On the other hand, it does not seem to be realized that during the all-out efforts of war-time, laboratory results may be developed on a large scale with little time-lag, which in peace always tends to be much longer. In a national emergency the cost factor in production is not so much emphasized, with the result that the material benefits arising immediately from research are exaggerated at the end of a great war. This belated discovery on the part of the Department of Scientific and Industrial Research proved to be a greater handicap on those research associations which with slender resources devoted themselves more to solving fundamental problems related to their industry than to obtaining immediate results on a short-term policy. The survey includes the authors' summation of the qualities required for a successful director of a large research organisation.

The often slow and tortuous history of the applications of science in Government Departments and the Services is effectively described.

On the whole, the book may be welcomed as giving an accurate picture of industrial research as it was in the early forties. It does not, however, sufficiently impress the reader with the difficulties of developing laboratory results into large-scale practice. The workers in this immense field will all regret that the authors, with so much experience, have designedly limited themselves to a purely descriptive account of past progress; and have made little attempt to draw general conclusions or to offer advice on future action.

Robert H. Pickard

Papers of the Michigan Academy of Science, Arts and Letters

Vol. 29 (1943). Pp. xiii + 606. (Ann Arbor, Mich.: University of Michigan Press; London: Oxford University Press, 1944.) 5 dollars; 28*s*. net.

THIS volume contains a number of papers in botany, forestry, zoology and other fields.

Two of the botanical papers deal with the marine algæ of Hong Kong and comprise the genera *Herposiphonia* and *Polysiphonia* by C. K. Tseng, University of Michigan. There is also an account of "Some Resupinate Polypores from the Region of the Great Lakes" which is the fifteenth number of a monograph on this subject. The paper contains an extensive key to the principal white resupinate polypores in culture. These fungi are discussed in three groups: (*a*) white, (*b*) brown, (*c*) those other than white and brown. The present paper, in which the first group is treated, is based largely upon studies of the rate of growth in culture and other features. It is intended to serve as a guide to the principal white resupinate polypores in North America.

Under the heading of geography is a paper on "Some Applications of Aerial Photographs to Geographic Inventory" by J. A. Russel, F. W. Foster and K. C. McMurry. It contains an extensive key by which an interpretation from air photographs can be carried out. The key contains features due to topography, drainage, soils, coasts and shores, plant life. Other sections are devoted to the characteristics of occupance such as rural production, transportation and urban forms. The section on plant life is detailed and should be of considerable value in the interpretation from aerial photographs of the distribution of different types of vegetation.

Den Danske Dyreverden

Dyregeografisk og indvandringshistorisk belyst. Af Ragnar Spärck. Pp. 116. (København: Ejnar Munksgaard, 1942.) 7.50 kr.

IN this book Ragnar Spärck has written an excellent summary of the general problems connected with the present distribution of the Danish fauna. At the present day, Denmark possesses a very uniform climate and a topography without extremes, and as would be expected under such conditions the majority of the species comprising the fauna are distributed over the whole area wherever they may find suitable habitats. A number of species are, however, confined to the southern districts and islands, some with a westerly and some with an easterly distribution. Rägnar Sparck has studied the distribution of these species in order to determine whether such distribution is due to human interference, climatic or ecological factors, or whether it has some reference to the period at which the species entered the country. The species considered are mostly vertebrates, but consideration is given to the distribution of a number of invertebrates, and there is a chapter on the fauna of the surrounding sea.

There is an excellent series of maps showing the distribution of certain species in Denmark, but it is a pity that these are confined to Denmark alone and that the distribution of the species in the Scandinavian Peninsula or elsewhere in Europe is not shown.

This book will be of great interest to all who are concerned in problems connected with the zoogeography of Northern Europe and post-glacial migration of the European fauna.

Language as a Social and Political Factor in Europe

By Stanley Rundle. Pp. 207. (London: Faber and Faber, Ltd., 1946.) 12*s*. 6*d*. net.

AS an example of the serious misunderstandings that can arise from lack of a common tongue Mr. Rundle quotes, among a number of instances, the English padre in the First World War who offered a benediction to some French troops in the words "Que Dieu vous blesse", and the story is characteristic of a book that treats a technical subject in a way that cannot fail to appeal to the non-specialist reader while conveying to him much sound and thoughtful information. The first part of the book sets out the difficulties caused by language differences, which Mr. Rundle summarizes in eight points. In the second part he gives a quantity of statistical and other material on the languages of Europe, and in the third he deals with the various projects for overcoming the difficulties, whether by learning a variety of languages, or agreeing to adopt one existing language, or forming a new, "artificial" language. To each of these suggestions he applies the test of his eight points, and though he offers no final conclusion the ideas he throws out are stimulating and provocative. His suggestion of three simple international languages, based on the division of Europe into three main language groups, Romance, Teutonic and Slav, though put forward almost as an afterthought, is at least as worthy of consideration as some of the other projects which he summarizes, and in passing he has some interesting suggestions to make about the teaching and learning of languages.

MAURICE BRUCE

The Chemical Composition of Foods

By Dr. R. A. McCance and Dr. E. M. Widdowson. (Medical Research Council, Special Report Series No. 235.) Second edition. Pp. 156. (London: H.M. Stationery Office, 1946.) 6*s*. net.

DURING the six years of its existence McCance and Widdowson's "The Chemical Composition of Foods" has come to be justly valued as the most comprehensive and authoritative compilation of its kind in Britain (and, indeed, in some respects, such as the mineral contents, in the world). The call for a second edition has prompted the authors to expand, and occasionally to modify, their initial findings. The expansion has swelled the number of entries from 541 to 609, the additions mainly stemming from war-conditioned alterations in the British dietary. Thus where two flours (white and wholemeal) were sufficient in 1940, no less than sixteen varieties have been entered in the 1946 edition. Among other newcomers are dried egg, household dried milk, chopped ham, and "sausage (1943)"—an ominous description that is belied, at least nutritionally, by the analytical data given. Several "economical" variants have been added to the long and useful list of cooked dishes, while the number of recipes has been correspondingly enlarged. This section of the Report, which takes into consideration such significant details as mechanical losses of raw materials during mixing, will be invaluable to dietitians. Catering, as they do, for a wide range of users, the authors continue to express compositions per ounce as well as per 100 "grammes" (but why this archaism ?).

One notable change in this edition is that the 1940 table of "available" (ionizable) iron contents has been dropped—a step reflecting recent changes in our ideas about iron availability.

N. T. GRIDGEMAN

THE AUSTIN WING OF THE CAVENDISH LABORATORY

By Sir LAWRENCE BRAGG, O.B.E., F.R.S.

IN May 1936 the late Lord Austin sent the following letter to the Chancellor of the University of Cambridge :

"Dear Mr. Baldwin,

"I have for several years been watching the very valuable work done by Lord Rutherford and his colleagues at Cambridge in the realm of scientific research, and knowing that as Chancellor you are keenly interested in obtaining sufficient funds to build, equip, and endow a very much-needed addition to the present resources, I shall be very pleased indeed to present securities to the value of approximately £250,000 for this purpose.

Yours sincerely,

H. Austin."

Of this munificent gift, a sum of £37,000 was at once applied to building and equipping a high-tension laboratory and installing a cyclotron. A further sum of £100,000 was set apart as a building fund ; £80,000 for a new wing of the Laboratory and £20,000 for alterations to the existing Cavendish block. The residue provides an annual income for the general research of the Laboratory.

The plans for the new wing were completed before Lord Rutherford's death ; but the actual building was not started until May 1938. Though many in the Laboratory had a part in the designs, the main responsibility for the plans rested upon Prof. J. D. Cockcroft. Building had not progressed very far at the outbreak of war, and at one time it appeared that work on it might have to stop. We were able to proceed, however, by giving an undertaking that accommodation would be found in the Laboratory for Service research departments if need should arise. Lord Austin laid the foundation stone in May 1939, and the building was completed by June 1940. It was at once occupied by the Admiralty Signal School and the Ballistics Directorate, Research Department, Woolwich, both of which had been driven from their homes by air attacks. Towards the end of the War, some sections of the building were handed back to the Laboratory, but we were not able to occupy the whole until January 1945. It had then to be decorated, furnished and provided with apparatus and machine tools ; it is now in full running order. The new wing was formally opened by Sir John Anderson on July 24 of this year, during the international physics conference arranged jointly by the Physical Society and the Cavendish Laboratory.

The architect, Mr. C. Holden, assisted by Mr. H. G. Cherry, designed for us a building which is very simple in plan, and at the same time is attractive and very convenient. It is 115 ft. in length by 45 ft. in width, and 55 ft. in height. Each of the four floors and the basement are of similar design, with rooms of standard size or multiples of this size on either side of a central corridor 8 ft. wide and 13 ft. high running the whole length of the building. The standard research room is 15 ft. by 17 ft., with two windows. The outer walls and walls of the corridor carry the strong concrete floors, on which rest light walls separating the research rooms, so that it is a simple matter to subdivide a room or to remove a dividing wall. There are also removable panels above the doors, and with so high and wide a corridor it is possible to move quite large units of apparatus into any room. The area occupied by the building is 9,000 sq. ft., and the total floor-space 34,000 sq. ft.

In planning the services to the rooms, flexibility was aimed at rather than a complete provision for all possible needs. The services come up a shaft next the lift-shaft, run along the sides of the corridors above the doors on open battens, and then enter the research rooms, so that it is easy to alter or add to them. The standard supplies of gas, water, electricity and compressed air are distributed around the walls of the rooms above a narrow shelf which corresponds in height to the tables used for research, leaving the centre of each room quite free. The electrical supplies from the D.C. generators are available in any room, and can be controlled from it.

The second floor houses the administrative centre of the whole Laboratory. It has rooms for the senior teaching staff and the clerical staff. A large bay is used for the museum of historic apparatus, and on its walls are displayed the annual

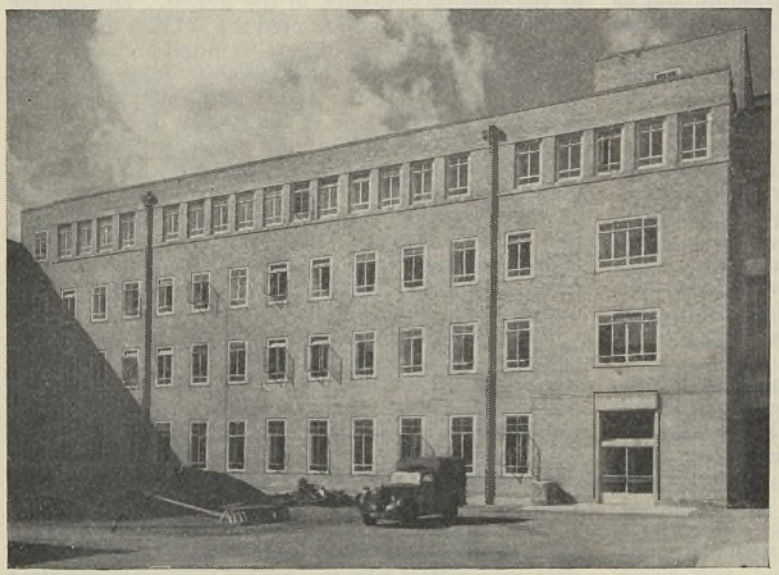


Fig. 1. Exterior of Austin wing

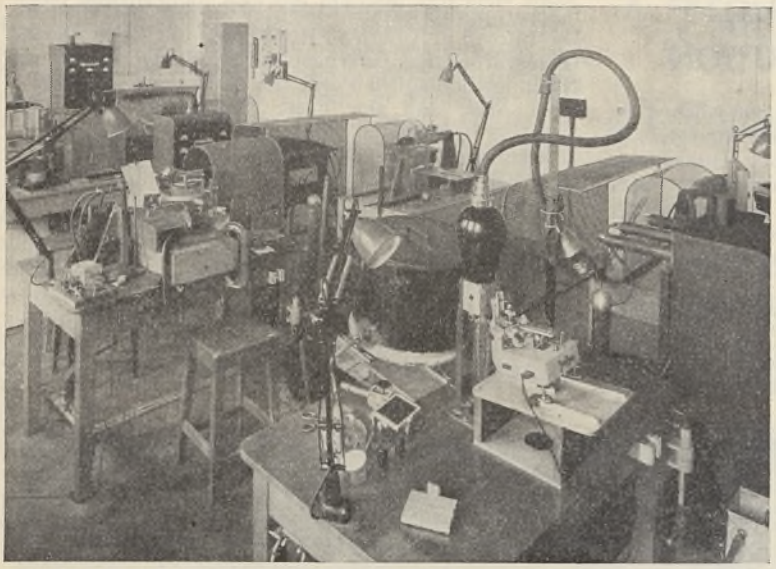


FIG. 2. A TYPICAL RESEARCH ROOM

photographs of staff and research students, a remarkable series running from 1897 which has only been broken during the two World Wars. A large room on this floor with an attached pantry is used for the Cavendish 'teas' and other social gatherings, and for conferences and committee meetings. The library is also on the second floor. The style of the rest of the Laboratory is purely functional, but on this floor we have aimed at providing a fitting Laboratory centre. In designing the furniture and decorations we had the help of Mrs. Hubert Worthington. A colloquium room seating about seventy is on the first floor beneath the library.

Another group of rooms provides for the main workshop, steward's office, students' workshop, glassblower's rooms, general storeroom, and standards room. There is also a 'special techniques' workshop where delicate operations requiring the highest technical skill are carried out.

Of the ninety rooms in the building, thirty-one are research rooms of unit or multiple unit size, and thirteen are offices. Store-rooms, dark rooms, generator room, heating and other services, together with the special rooms mentioned above, account for the remainder. No part of the building is used for undergraduate teaching, though all students use the library.

Even with the most careful planning and foresight, certain needs only become apparent when a building comes into service. Much apparatus for physical research is now on an engineering scale. A large covered space near the workshop, for packing and unpacking and for storing gear before it is assembled, would be a great boon, and it is not provided for in the present wing, which had to be planned on a restricted site. The amount of 'junk' carried by the Laboratory is also on a correspondingly large scale. It is a most important liquid asset, exceedingly useful for research purposes of all kinds. A large space should be set aside for it where it is easily accessible and can be classified, otherwise it clutters up valuable research rooms or the corridors. Another need is for many more small 'offices'. In former days a researcher, working with small-scale apparatus, could have a desk in the corner of his laboratory, where he kept his papers and did his calculations. Now that many research rooms resemble the interior of a power-station, this is no longer convenient. Researchers greatly value private cubicles, however small, where they can work or talk with their colleagues in quiet surroundings. I mention these needs because our experience may be of interest to others who are planning laboratory extensions. On the whole, the planning of the new wing has been highly successful, and the competition to work in its convenient and attractive research rooms is very keen.

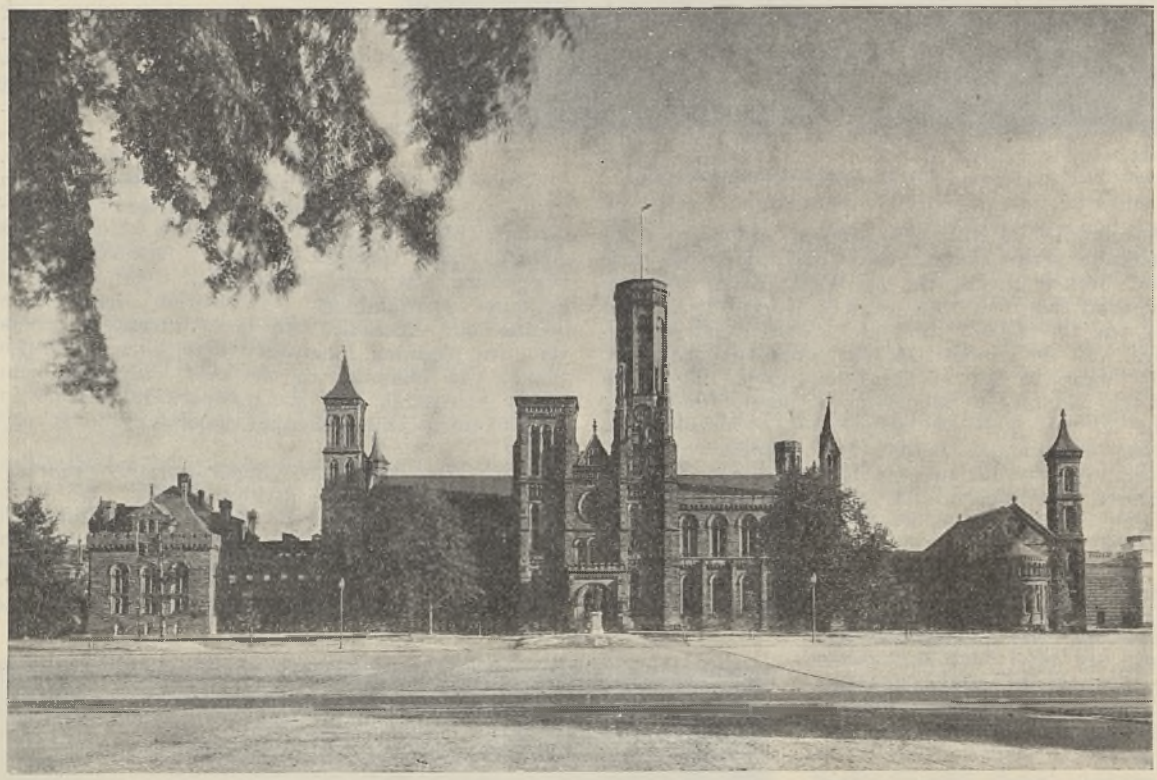
The building cost £77,000, apparatus and equipment £10,000, furniture and fittings £4,500. We were indeed fortunate that it was built at the beginning of the War; quite apart from the cost, the same high standards will be impossible to attain for many years to come.

FIG. 3. LIBRARY

CENTENARY OF THE SMITHSONIAN INSTITUTION

THE Smithsonian Institution was established on August 10, 1846, in accordance with the terms of the will of James Smithson, a wealthy Englishman interested in science. At his death, seventeen years before, he had left his fortune of approximately 550,000 dollars to the United States to set up in Washington an institution "for the increase and diffusion of knowledge among men".

The establishment thus became the first of the great endowed scientific organisations which have been in a major degree responsible for the great cultural and material progress of the last century.



THE SMITHSONIAN INSTITUTION

Among all such institutions everywhere the Smithsonian has had a unique position. It has been intimately associated with the National Government, yet at the same time it has had the freedom of action associated with private foundations. It has been from the beginning a torch-bearer of scientific research in the United States. At the time of its establishment the pursuit of science was largely that of interested individuals, dependent on their own resources, which never were adequate for the long-term, basic, laborious researches essential for a true understanding of Nature.

Owing to its close association with the Government, the Smithsonian has enjoyed exceptional facilities from the beginning. To-day it administers and directs the research activities of several scientific and cultural bureaux, most of which are supported by direct federal appropriations—notably the National Museum, the Bureau of American Ethnology, the Astrophysical Observatory, the International Exchange Service, the National Zoological Park, the National Collection of Fine Arts, and the Freer Gallery of Art. The National Gallery of Art also is a bureau of the Institution, but is administered by a separate Board of Trustees. In addition, the Institution carries out independent pioneer work with its own funds.

The Smithsonian Institution has become known to the general public for its enormous collections, many of which are on continuous exhibition, ranging from dinosaurs to aeroplanes and from famous paintings to the dresses of Presidents' wives. The great value of the collections, however, is in their service to science. Here it is possible for experts to check the identity of nearly any animal, plant, or mineral found in the world, either extinct or extant. These collections now include nearly twenty million items—a number that increases constantly at a rate of more than a quarter of a million a year. The greatest number of items is in the field of natural history. In the beginning the Smithsonian had essentially a scientifically unexplored continent as a field for its collectors and explorers. Year after year it has sent out collecting expeditions to all parts of the world, including, of course, all sections of the United States.

The interest of Smithsonian explorers has been to obtain and preserve as complete as possible a picture of all Nature in its infinite manifestations. The Institution maintains departments in all the major branches of natural history, from entomology to physical anthropology.

The Smithsonian was the pioneer, and ever since has been among the leaders, in all scientific research dealing with the aboriginal peoples of the Americas. These now are conducted largely by a Government-supported division—the Bureau of American Ethnology. At the time this work started just after the American Civil War, scientific interest in the remains, languages, and ways of primitive peoples was in its infancy. Thus the work of the Bureau, with the exceptional facilities at its disposal, has been fundamental in the development of the entire science of ethnology, and its publications are considered basic documents of this science all over the world.

Samuel P. Langley was a pioneer in the development of aviation. His steam-driven model "aerodromes" flew without a pilot repeatedly for distances of more than half a mile as early as 1896. The Smithsonian collection of aeroplanes which have played notable parts in aviation history is probably the largest in the world.

Study of precise solar-terrestrial relationships has been a major Smithsonian activity for many years. This has involved especially very exact measurements of periodic variations in the sun's radiation and the mechanism of photosynthesis in green plants. Observations now are carried out daily at three observatories on high mountain-tops in California, New Mexico, and Chile. This work has required development of measuring instruments of almost incredible delicacy—one of them capable of measuring a change of heat as small as one-millionth of a degree.

In the United States originated such devices as the telegraph and telephone, the cotton gin, the sewing machine, the harvester, and scores of others. The original machines are objects of historic interest to the American people. The Smithsonian has the responsibility for collecting and preserving these historic prototypes. The Museum collections of the Smithsonian are visited by more than two million persons each year.

The American history collections are especially rich. Perhaps the best-known items are dresses of ladies of the White House from Martha Washington to Mrs. Franklin D. Roosevelt.

In carrying on "the diffusion of knowledge", the Institution has published more than 7,500 individual books and pamphlets in nearly every field of science, most of them based on original research. It also maintains a large library of scientific books and pamphlets, covering all the fields in which it is chiefly engaged.

In the field of art the Smithsonian has three bureaux, as follows :

The National Gallery of Art, given to the nation by the late Andrew W. Mellon and containing his own collections, as well as other famous collections. The National Gallery is administered by a separate Board of Trustees.

The Freer Gallery of Art, one of the most important collections of Oriental art in America, a gift to the people of the United States from the late Charles L. Freer of Detroit.

The National Collection of Fine Arts, a generalized collection which is temporarily housed in the U.S. National Museum, pending authorization of a new building.

A FREQUENCY ANALYSER USED IN THE STUDY OF OCEAN WAVES

By N. F. BARBER, F. URSELL, J. DARBYSHIRE
AND
M. J. TUCKER
Admiralty Research Laboratory, Teddington

A WAVE-ANALYSER was developed at the Admiralty Research Laboratory, Teddington, in 1944 in order to analyse ocean waves and swell and ship movement. The apparatus has been in regular use since February 1945 drawing the frequency spectra of records of wave motion taken near Lands End.

These records of water pressure or depth are taken continuously for 20 minutes, and appear in the form of a black trace of variable width on white photographic paper. Fig. 1 shows a short length of record. On one side of the record is a time trace

Fig. 1. A WAVE-PRESSURE RECORD

consisting of a black strip interrupted every 20 sec. By attaching the paper record to the outside of the rotating wheel in Fig. 2, photocells, illuminated by the reflected light from a narrow light beam falling on the record, give a fluctuating electrical output which is a repetition at high speed of the fluctuating trace on the record.

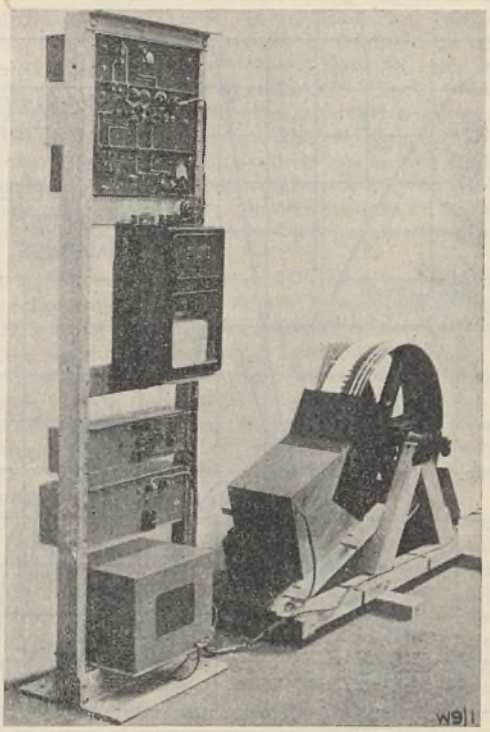


Fig. 2. THE FREQUENCY ANALYSER

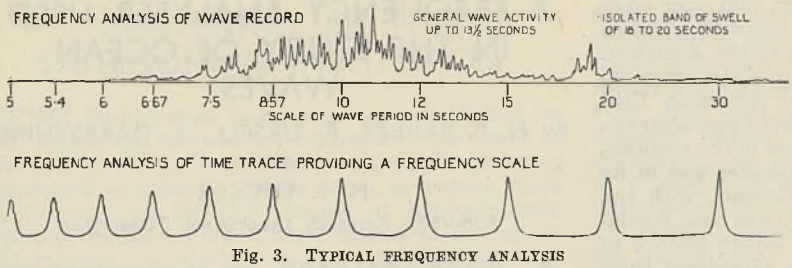


Fig. 3. Typical frequency analysis

This electrical output is amplified and made to drive a vibration galvanometer. By allowing the speed of the rotating wheel to decrease slowly, the vibration galvanometer is caused to resonate in turn with the various component wave-lengths on the original record. Thus the vibration galvanometer of natural frequency 120 c. per. sec. resonates with the output of a wave-length 1/30 of the periphery of the wheel when the wheel is turning at 4 rev. per sec., but resonates with the output from a wave-length 1/40 of the periphery of the wheel when the speed of the wheel has fallen to 3 rev. per sec. Regarding the record as being compounded of its Fourier harmonics, each having a whole number of wave-lengths on the periphery of the wheel, one can see that provided the vibration galvanometer is sharply tuned and that the speed of the wheel decreases very slowly, the vibration galvanometer will show individual resonances to each Fourier component.

The motion of the galvanometer is detected photo-electrically and the output is amplified, rectified and made to drive a pen recorder the deflexion of which at any instant is, therefore, a measure of the amplitude of vibration of the galvanometer. The most recent model uses a vibration galvanometer with an electrical output, developed by G. Collins. The sample pen record shown in Fig. 3 is the analysis of the record of which Fig. 1 is a portion.

A frequency scale is drawn automatically by a second pen giving the lower trace in Fig 3. This pen is actuated by a second channel working photo-electrically from the time trace and using a resonant filter tuned to 360 cycles. The second pen, therefore, draws a frequency analysis of the time trace, and this consists of a series of isolated peaks which can be used to interpolate a scale of frequency for the trace of the first pen. Because of the 3 : 1 ratio in the resonant frequencies of the two channels, these peaks are equivalent to wave-periods of submultiples of 3 × 20 or 60 sec., that is, 60, 30, 20, 15, 12, 10 sec., and so on.

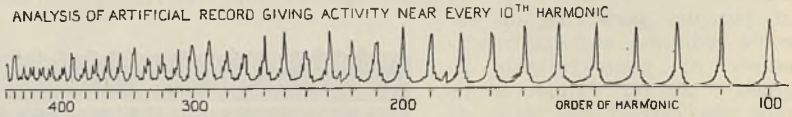


Fig. 5. Analysis of artificial record showing resolution of frequency bands

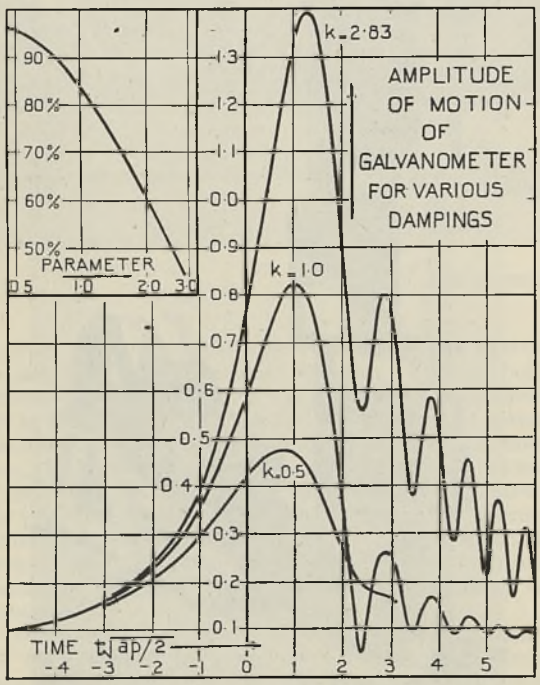


Fig. 4. Amplitude of oscillation of galvanometer for various dampings

It will be appreciated that the mechanical parts of the apparatus are simple and that the process of analysis is automatic. There is no mechanical drive to the wheel, which, having been turned by hand to its top speed, continues to revolve under its own inertia at a slowly decreasing speed, the analysis proceeding automatically. In the apparatus already built, the wheel is 30 in. in diameter and weighs 70 lb.; it is carried in ball bearings, and takes about 4 minutes to decrease to half speed. As for the electronic amplifiers, it is not necessary for them to have an amplification which is the same over a wide range of frequency, since the only electrical frequencies that are important are in a narrow belt near 120 c. per sec. It is important, however, that the amplifiers should be linear in the sense that they produce no spurious 120 cycles coming from sum or difference of the various frequencies in the input. Linearity is also important in the optical pick-up from the record, in the sense that the illumination of the photo-electric cell must be strictly proportional to the width of the white part of the illuminated area of the record.

In practice, it is found that an analysis covering four octaves takes place in about 16 minutes, and that an operator can deal conveniently with about fifteen analyses each day.

The analysis approximates to a Fourier amplitude analysis, and it has been found possible to determine theoretically the optimum characteristics of the apparatus. Each of the Fourier components of the record produces an electrical component the frequency of which is slowly gliding as the wheel decreases in speed. If the speed of the wheel decreases at a rate $\exp - at$ and the vibration galvanometer has a natural frequency $p/2\pi$ and a natural rate of decay of free oscillations of $\exp -bt$, then it can be shown that the manner in which the oscillations of the

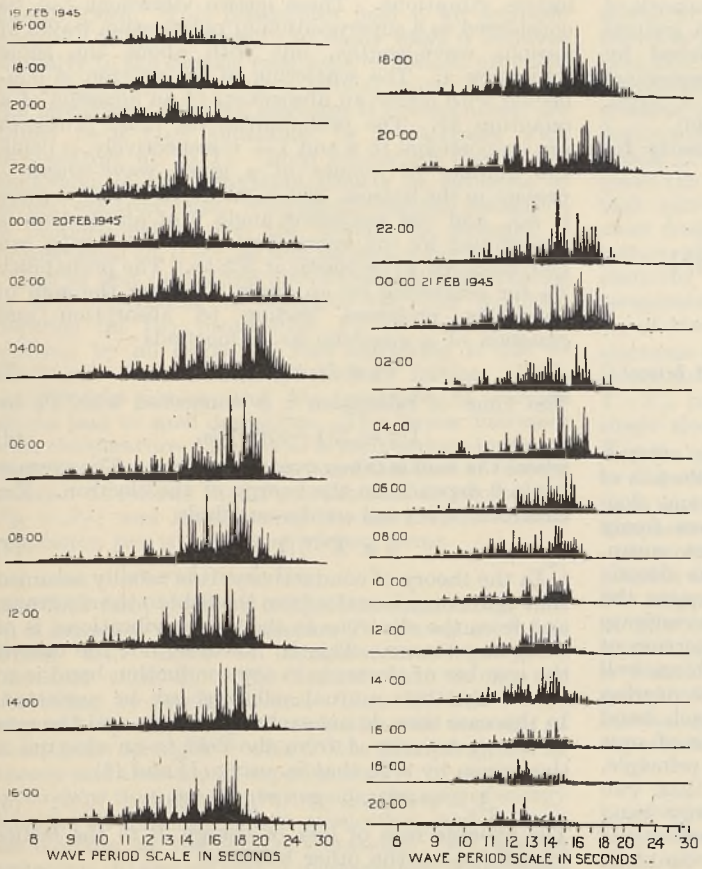


Fig. 6. A SERIES OF WAVE-PRESSURE SPECTRA

galvanometer build up and decay in amplitude as the gliding tone passes through resonance is determined by a parameter k, where $k = \sqrt{a/2pb^2}$.

Fig. 4 shows the response curves of the galvanometer for various values of k. They illustrate in particular the effect of changing the damping of the galvanometer without changing the rate of decay in speed of the wheel. With fairly large damping, $k = 0{\cdot}5$, the galvanometer builds up slowly to a small amplitude of resonance and decays smoothly. With smaller damping the peak is higher and sharper, but the decay is executed in a series of beats. With very small damping the galvanometer builds up to a limiting amplitude and proceeds to beat, but the time of decay of the motion is very long. Taking the effective width of the response as the interval in which the response exceeds 1/10 of its maximum value, it is clear that there is an optimum damping at which the width of the response curve is least. This is approximately at

$$k \text{ (optimum)} = 1{\cdot}8.$$

This optimum value of k gives the greatest resolution of the Fourier components. When the galvanometer is giving its peak response to one Fourier component, it is being slightly affected by adjacent components the gliding tones of which have either not yet reached the natural frequency of the galvanometer or have passed through it. If we consider the components to be adequately resolved when the contribution from each adjacent harmonic is less than 10 per cent of the peak response to that harmonic, it is possible to show from the curves of Fig. 4 that in any given apparatus all the harmonics are resolved up to the Nth, where

$$N = 0{\cdot}12\sqrt{p/a},$$

assuming that the damping b is at its optimum value for the p and a specified. It is clear that an analyser can be constructed to resolve any desired number of harmonics.

For the apparatus at present in use

$a = 0{\cdot}0028$ (decay to $\frac{1}{2}$ in 4 min.)

$p = 750$ (natural frequency 120 cycles);

so that for optimum working at $k = 1{\cdot}8$ we should have

$b = 0{\cdot}001$ (decay to 1/10 in 3 sec.),

and the harmonics are resolved as far as

$$N = 60.$$

At $N = 120$ the adjacent harmonics contribute about 25 per cent of their peaks, and at $N = 240$ they contribute about 50 per cent, so that the peaks merge together. At higher harmonics the mean amplitude of vibration of the galvanometer may be taken as proportional to the square root of the sum of the squares of the amplitudes of the Fourier components in about a 1 per cent range of frequency. Even at high orders of harmonics the apparatus clearly separates isolated frequencies which differ by more than 3 per cent. Fig. 5 shows the analysis of an artificial record producing frequency belts near every 10th harmonic. These belts of frequency are resolved up to about the 400th and 410th harmonic, where the frequencies differ by $2\frac{1}{2}$ per cent. It is difficult to construct simple artificial records which have prescribed amounts of high harmonics, but the analysis of such records has shown that the amplitudes of the Fourier components up to the 60th are correct to 5 per cent; this error might be increased to 10 per cent, when a number of adjoining frequencies are present.

A wheel with mechanical drive and variable, controlled, exponential rate of decay, designed by F. E. Pierce, is being constructed in the workshops at the Admiralty Research Laboratory. With this wheel, which can be rotated up to 10 revolutions a second, more favourable characteristics can be chosen for damping and natural frequency, to allow greater resolution in an analysis taking the same time. Complete instruments are being made by Messrs. H. Tinsley & Co. Ltd.

The propagation of waves away from storm areas has been investigated with this analysis. Rules have been found which will allow improvement of methods of forecasting swell, a subject of interest to harbour and shipping authorities.

Fig. 6 shows a series of Fourier amplitude spectra of pressure at the bottom of the sea at a point off the Cornish coast. It is clear that there is a general trend in these analyses; it will be shown elsewhere that this is consistent with classical hydrodynamicla theory. It is expected that rapid progress will

continue to be made, particularly after a network of recording stations has been established. A general account of the problem has been published by Deacon in "Ocean Waves and Swell", Occasional Publications of the Challenger Society, No. 1, April, 1946, pages 1–13 (see *Nature*, 157, 165 ; 1946).

We are indebted to the Board of Admiralty for permission to publish this article.

THEORETICAL PHYSICS IN INDUSTRY*

By Dr. H. FRÖHLICH

H. H. Wills Physical Laboratory, University of Bristol

Free Electrons in Solids

In considering the behaviour of electrons in crystalline solids, a well-known theorem by F. Bloch is of great importance. According to this theorem, electrons in a perfectly periodic lattice move freely without being scattered. This does not mean, however, that all electrons contribute to the electric conductivity, because this would also require the possibility of accelerating electrons. To investigate this question we notice that the energy spectrum of electrons in a crystal consists of bands which are well separated in the low-energy region but which overlap at high energies. For simple structures each band contains N levels, where N is the number of unit cells. According to the Pauli exclusion principle, each level can be occupied by no more than two electrons. It thus follows that each energy band accommodates $2N$ electrons. The average velocity of all electrons in a completely filled band vanishes. Thus in the energy region in which bands do not overlap, a completely filled band does not contribute to the conductivity, because there are no empty levels into which an electron can be accelerated. This case is realized in insulators at low temperatures, where the highest occupied level coincides with the upper edge of an energy band in the region where bands do not overlap. In metals, on the other hand, there is at least one energy band which is not completely filled.

Consider now an insulator. To produce an electric current, electrons must be lifted into a normally empty band. This transition can be made either thermally, optically or by very strong fields. An electron in one of these conduction bands will be treated as a free electron with kinetic energy E. Such an electron will be scattered by any deviations from a strictly periodic lattice such as temperature vibrations or lattice defects. In view of this scattering, the average velocity $\bar{v}$ of an electron vanishes in the absence of an external electric field. In the presence of a field, electrons are accelerated in the direction of the field. In a very crude picture, one can imagine that each electron is accelerated for a time 2τ, after which it loses its additional velocity. Thus the average velocity of an electron is

$$\bar{v} = eF\tau/m, \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

and hence the current density is

$$e^2F\tau z/m,$$

where z is the number of free electrons per unit volume. Consider an ionic crystal without lattice defects, so that the scattering is entirely due to the lattice vibrations. These lattice vibrations can be considered as a superposition of polarization waves of various wave-lengths, but with about the same frequency ν. The scattering of an electron is connected with either an absorption or an emission of a quantum $h\nu$. The probabilities for these processes are proportional to n and $1 + n$ respectively, n being the number of quanta of a given wave-length λ present in the lattice. The momentum of such a wave is h/λ, and the scattering angle θ of an electron is determined by the momentum law. Scattering can be considered to be elastic if $E \gg h\nu$. The probability P_θ for scattering by an angle θ is then the sum of scattering processes leading to absorption and emission of a quantum $h\nu$. One finds

$$P_\theta \propto (1 + 2n)/\sqrt{E} \quad . \quad . \quad . \quad . \quad (2)$$

The time of relaxation τ is connected with P_θ by

$$1/\tau = \Sigma(1-\cos\theta)P_\theta, \quad . \quad . \quad . \quad (3)$$

where the sum is taken over all angles θ. The average angle θ depends on the energy of the electron. For electrons of several e-volts one finds

$$\tau \propto E^{3/2}/(1 + 2n) \quad . \quad . \quad . \quad (4)$$

In the theory of conductivity, it is usually assumed that the energy transfer from the field to the electrons, and from the electrons to the lattice vibrations, is of little importance. This is, however, not the case if the number of electrons in the conduction band is so small that their mutual collisions can be neglected. In this case they do not exchange energy, and the rate of energy transfer A from the field to an electron is thus given by $e\bar{v}F$, that is, using (1) and (4)

$$A = e^2\tau F/m \propto E^{3/2}F^2/(1 + 2n) \quad . \quad . \quad . \quad (5)$$

The average rate of loss of energy B to the lattice vibrations, on the other hand, is

$$B \propto \frac{1 + n - n}{\sqrt{E}}, \text{ that is, } B \propto 1/\sqrt{E}, \quad . \quad . \quad (6)$$

because the probability for absorption or emission of a quantum $h\nu$ is proportionally to $n/\sqrt{E}$ and $(1+n)/\sqrt{E}$ respectively. Now so long as B is greater than A, a single electron with energy $E \gg h\nu$ will on an average lose energy at a higher rate than it gains energy. This is reasonable because the Maxwell distribution function $\exp. -E/kT$ has its highest value at $E = 0$. From (5) and (6) it follows, however, that B decreases and A increases with E. Thus at sufficiently high energies an electron will on an average gain more and more energy. It will be shown later that this may have important consequences.

A difficulty connected with the motion of slow electrons in ionic crystals concerns the polarization of the crystal near the electron. If ν is the frequency of oscillation of an ion, it will take about $1/\nu$ sec. for an ion to be displaced by the field of the electron. In this time an electron of velocity v moves a distance $r_0 = v/\nu$. This means that only at distances larger than r_0 is the polarization proportional to the Coulomb field of the electron. Hence the energy of polarization depends on r_0. It is of the order $-e^2/r_0 = -e^2\nu/v$. For small velocities this term may become more important than the kinetic energy $mv^2/2$. No detailed study of the influence of polarization on the motion of electrons has been made yet.

Theory of Dielectric Breakdown

Consider a solid dielectric to which an external electric field is applied. If the field-strength inside the dielectric exceeds a critical value, the insulation

* Substance of a course of three lectures delivered at the Royal Institution on March 28, April 4 and 11.

breaks down. This breakdown field is an intrinsic property of the material. In many ways it behaves similarly to the electric resistance of metals, provided the temperature is below a critical value T_c. Thus the breakdown strength increases if foreign atoms are added to a pure substance, or it increases with temperature up to T_c. Both effects are due to the behaviour of the relaxation time τ of electrons of several electron volts. Whereas the electric resistance is proportional to $1/\tau$, the breakdown strength is proportional to $1/\sqrt{\tau}$, as will be shown below.

Let us first derive the above-mentioned properties of $1/\tau$. According to equation (3), this quantity depends on the probability P_θ of scattering an electron by an angle θ. This scattering is due to deviations from a strictly periodic lattice. Both temperature-motion and the presence of foreign atoms lead to such deviations. The former increases with temperature. The latter is temperature-independent but increases with the concentration of foreign atoms. It follows that P_θ is the sum of two terms, $P_{th} + P_f$; and hence, using (3), the inverse time of relaxation too is composed of two terms

$$1/\tau = 1/\tau_{th} + 1/\tau_f \quad . \quad . \quad . \quad . \quad (7)$$

The first term refers to temperature-scattering, that is, it increases with temperature T. (In equation (4), which also refers to temperature-scattering, n increases with T.) The second term is due to scattering by foreign atoms. Thus $1/\tau$ behaves as required by experiment. Actually the increase of breakdown strength F with T was first predicted by theory and then found experimentally.

To show that $F \propto 1/\sqrt{\tau}$, consider the rate of energy transfer A, from the field to an electron, and B, from an electron to the lattice vibrations. We saw in equations (5) and (6) that A increases and B decreases with the energy of an electron. Thus an energy E' must exist where A is equal to B. For $E>E'$, electrons gradually drift to higher and higher energies. Thus a stationary state would seem to be impossible. Actually the above considerations hold only if $E<I$, where I is the energy required for an internal ionization of an ion or atom of the lattice, and the field will produce additional ionization only if $E'<I$. Hence $E' = I$ will be taken as condition for breakdown (it has not been possible to give a more exact derivation of this condition. An exact calculation shows, however, that the possibility of reaching stationary conditions is entirely determined by the behaviour of electrons with an energy $E>I$, which lends support to the condition used above.) Taking $E' = I$, then $(A = B)_{E=I}$, or with (5)

$$e^2F^2 = (mB/\tau)_{E=I}\,; \text{ that is, } F \propto 1/\sqrt{\tau}$$

as required. As a further consequence of this theory thin layers should have a higher breakdown strength than the material in bulk. Actually it was found that a layer of mica of about 10^{-5} cm. thickness has about twice the electric strength of a thick layer.

Experiments on the temperature-dependence of the breakdown strength F show that above a critical temperature T_c the dielectric strength decreases with temperature. It was also found that for amorphous solids T_c is in general much smaller than for crystals. Thus the theory sketched above holds only below T_c. To show that this has to be expected, it should be remembered that the calculation of the rate of energy exchange A and B was based on the assumption that there are so few electrons in the conduction band that their mutual collisions can be neglected. Actually it is known that in strong fields (but below breakdown strength) the number of electrons in the conduction bands is higher than in the absence of a field, and that this number increases with temperature. Thus a temperature will be reached where it is no longer possible to neglect collisions between electrons. To derive a theory of breakdown at this high-temperature region ($T>T_c$) assume that T is sufficiently large to make the density of electrons in strong fields so high that mutual collisions between electrons are much more frequent than collisions between electrons and lattice vibrations. It can then be assumed that the electrons are in a thermal equilibrium, but at a temperature T which is higher than the temperature T_0 of the lattice. Thus energy will flow from the electrons to the lattice at a rate $\bar{B}(T,T_0)$ which can be shown to increase, for small temperature differences $T-T_0$, proportionally to $T-T_0$; but referred to a single electron the rate approaches a finite value as $T \to \infty$. In equilibrium, this quantity must be equal to the average rate of energy transfer $\bar{A}$ from the field to the electrons. From $\bar{A} = \bar{B}$ the electronic temperature T can be calculated.

A more detailed investigation shows that this is possible only if the field is below a critical value F. For larger fields no equilibrium can be attained, that is, the electronic temperature increases until the crystal breaks down. The temperature-dependence is found to be $F \propto \exp \Delta V/2kT_0$, where ΔV is a constant energy. Thus, for $T>T_c$, F decreases with increasing lattice temperature in agreement with experiment.

Theory of Dielectric Loss

Consider now solids which consist of molecules containing electric dipoles (for example, ice, ketones). If an alternating electric field is applied to such a solid, energy will be transferred from the field to the solid. Let E, P and D be the field strength, polarization and electric displacement respectively,

$$\text{that is, } D = E + 4\pi P \quad . \quad . \quad . \quad . \quad (8)$$

The energy-loss is due to a phase shift of the polarization relative to the field. Thus if

$$E = E_0 \cos\omega t, \quad . \quad . \quad . \quad . \quad . \quad (9)$$

$$\text{then} \qquad P = P_1 \cos\omega t + P_2 \sin\omega t \quad . \quad . \quad . \quad (10)$$

It follows from Maxwell's equations that the rate of change of the energy of the electric field is

$$\dot{U} = E\dot{D}/4\pi,$$

or using (8), (9) and (10)

$$\dot{U} = -\frac{E_0}{4\pi}(E_0 + 4\pi P_1)\omega\cos\omega t\sin\omega t + E_0P_2\omega\cos^2\omega t.$$

On an average, over a full period the first term vanishes and thus $\bar{\dot{U}} = E_0P_2\omega/2$. Usually one introduces a complex dielectric constant $\varepsilon = \varepsilon_1 - i\varepsilon_2$. The relation $D = \varepsilon E$ is then understood in such a way that the right-hand side represents the real part of $\varepsilon E_0 \exp i\omega t$. It then follows that

$$4\pi P_2 = \varepsilon_2 E_0, \quad . \quad . \quad . \quad . \quad (11)$$

and hence the dielectric loss is

$$\bar{\dot{U}} = E_0^2\omega\varepsilon_2/8\pi\,; \quad . \quad . \quad . \quad (12)$$

that is, ε_2 is proportional to the dielectric loss per cycle.

The phase-shift of the polarization which determines the dielectric loss (cf. equations (10), (11), and (12)) is due to the fact that it takes some time to establish equilibrium in an external field. To account for this

phase-shift, consider the dipolar structure of solids. In most cases dipoles have two or more equilibrium positions. They oscillate around one equilibrium position with a frequency $\omega_0/2\pi$, but occasionally they jump into another one. An external field acts in two ways on the dipoles. (i) The dipole direction in the equilibrium positions is changed, and (ii) the distribution of dipoles over the various equilibrium positions is also altered. Let τ_1 and τ_2 be the times required to establish equilibrium for the two cases. Then in the second case, this time, together with the frequency of the field, entirely determine the frequency-dependence of ε_2, which in this case is of the so-called Debye type,

$$\varepsilon_2 \propto \frac{\omega\tau_2}{1+\omega^2\tau_2^2} \quad . \quad . \quad . \quad . \quad (13)$$

Thus ε_2 has a maximum when $\omega = 1/\tau_2$. In the first case, however, loss is of the resonance type and is determined not only by τ_1, but also by ω_0 :

$$\varepsilon_2 \propto \tfrac{1}{2}\left\{\frac{\omega\tau_1}{1+(\omega+\omega_0)^2\tau_1^2} + \frac{\omega\tau_1}{1+(\omega-\omega_0)^2\tau_1^2}\right\} \quad . \quad (14)$$

In this case ε_2 has a maximum when

$$\omega = (1+\omega_0^2\tau_1^2)^{1/2}/\tau_1.$$

Thus if $\omega_0\tau_1 \ll 1$, both types of loss behave similarly ; but for $\omega_0\tau_1 \gg 1$, the maximum of ε_2 in (14) lies always near ω_0. This second type of loss is expected to be of importance in the region of ultra-short waves, but detailed comparisons with experiments have not been carried out yet. For longer waves the Debye loss gives, in general, a reasonably good description of experiments if one admits the existence of a whole range of relaxation times τ_2. So far, however, in only a few cases has it been possible to calculate the actual value of τ_2 from the structure of the solid.

THE FOOD AND AGRICULTURE ORGANISATION

THE Food and Agriculture Organisation (F.A.O.) of the United Nations, on the invitation of the Interim Commission on Food and Agriculture, held the first session of its Conference at Quebec during October 16–November 1, 1945. The report of the proceedings has now been published*.

With the formal establishment of the Food and Agriculture Organisation, the Interim Commission, which had been in being since the Hot Springs Conference, ceased to exist, and tribute is paid to the high quality of its work, which has provided sound foundations for future developments and greatly facilitated the business of the first session of the succeeding body. At the close of the Conference, membership of the Food and Agriculture Organisation consisted of forty-two countries and in addition four others were represented as observers. Sir John Boyd Orr, well known for his valuable work both in the realms of agriculture and nutrition, has been appointed director-general, and many distinguished specialists with a wide diversity of experience are among the members of the various committees. L. B. Pearson (Canada), as chairman of the first session, writes an introductory letter to the report, explaining the framework of the Organisation, setting forth its aims and calling upon the various governments for the necessary support to implement its recommendations.

The task before the Conference was immense and many of the recommendations are necessarily those of long-term policy. Care has been taken, however, that problems of immediate urgency should not be overlooked, for it is asserted that substantial improvements in production, nutrition and rural welfare could be effected merely by a more energetic application of existing knowledge and facilities.

The avoidance of overlapping between different organisations working in the same field is clearly desirable, and the winding up of the International Institute of Agriculture and the Comité International du Bois in favour of the Food and Agriculture Organisation is recommended. At the same time, the necessity for co-operation with any appropriate national organisation already in existence is repeatedly stressed, and the greatest importance is attached to the representation of the Organisation at all international discussions on commodity arrangements in respect of food and other agricultural products.

The work of the Conference was divided into two parts. Commission A dealt with the broad subject of policies and programmes, and consisted of six committees concerned respectively with nutrition and food management, agriculture, forestry and forest products, fisheries, marketing and statistics.

Commission B devoted its attention to organisation and administration, and was made up of four committees dealing with rules and procedure, finance, administrative arrangements, and constitutional and diplomatic questions respectively.

The reports of the various committees of Commission A leave no doubt as to the need for such a body as the Food and Agriculture Organisation. International co-operation and a linking together of production and consumption, and of industry with agriculture are essential if any solution is to be found for the innumerable problems of the world to-day. The fear of over-production is almost universal among Western farmers, but neither unrestricted competition nor control of output will meet the situation. Only by finding the necessary balance between production and consumption can the danger be removed. In the less developed but densely populated countries, though the immediate need is for agricultural improvements, industries must be developed to provide employment for the surplus population and raise the standard of living. A large proportion of the world's population is undernourished, quite apart from the special problems created by the Second World War, and one of the immediate tasks of the Organisation is to get needed foods to certain vulnerable groups such as young mothers and children. In these poor countries it is suggested that demonstration areas should be set up where educational schemes and food distribution can be carried out, and the production of more protective foods such as milk and vegetables be specially encouraged. Assistance with seeds, fertilizers, machines and advisory services are also a first call on the Organisation's activities in such countries. Further programmes for raising the standard of livestock and crops, irrigation and soil improvement are envisaged in the near future.

The world's undeveloped forests, especially those of tropical regions, present a unique opportunity for the Food and Agriculture Organisation. Besides being

* Food and Agriculture Organisation of the United Nations. Report of the First Session of the Conference held at the City of Quebec, Canada, October 16 to November 1, 1945. Pp. xxi + 89. (Washington, 6 : F.A.O., 2000 Massachusetts Avenue, N.W., 1946.)

CHELSEA POLYTECHNIC

S.W.3

DEPARTMENT OF MATHEMATICS

SESSION 1946–47

Students are prepared for the Internal and External General and Special Degrees in the Faculty of Science of the University of London. There are special facilities for part-time day and evening students. In addition, the following special evening lecture courses have been arranged :

(1) "The Mathematics of Quantum Mechanics," by Dr. L. Pincherle. Tuesday, 6.30 p.m., commencing October 8, 1946.

(2) "The Mathematics of the Theory of Elasticity," by Dr. D. Leggett. Wednesday, 7 p.m., commencing October 9, 1946.

(3) "Advanced Mathematics for Chemists," by A. Maccoll, M.Sc. Monday, 6.30 p.m., commencing October 7, 1946.

(4) "Industrial Statistics," by G. A. Barnard, M.A. Tuesday, 6 p.m., commencing October 8, 1946.

(5) "The Mathematical Theory of Electricity and Magnetism," by Miss G. Roper, M.A. Monday, 6 p.m., commencing September 23, 1946.

(6) "The Theory of Functions of a Complex Variable," by A. E. Ludlam, M.Sc. Monday, 6 p.m., commencing September 23, 1946.

(7) "The Functions of Mathematical Physics," by A. E. Ludlam, M.Sc. Monday, 7 p.m., commencing September 23, 1946.

Detailed syllabuses of courses (1), (2), (3) and (4) may be had on application to the Head of the Department of Mathematics, who will be pleased to give any other information required.

Courses (4), (5) and (6) prepare students for the M.Sc. degree of the University of London, but the courses are open to other students having the necessary mathematical background.

F. J. HARLOW, M.B.E., Ph.D., B.Sc.,
Principal.

MYCOLOGIST FOR THE TEA RESEARCH INSTITUTE OF CEYLON

Applications are invited for the post of Mycologist at the Tea Research Institute of Ceylon, St. Coombs, Talawakelle, Ceylon. Applicants should possess an honours degree in Botany and produce definite evidence of ability to carry out independent research. Preference will be given, other qualifications being equal, to a man with experience of fungus and virus diseases of plants. Alternatively, arrangements might be made for a suitable man to obtain further training in the latter subject before proceeding to Ceylon. Salary in the scale £600–40–1,200 (payable in Ceylon at Rs. 15s. to the £) with free quarters and heavy furniture. A higher initial salary may be given to a man with special experience. A temporary Dearness Allowance (at present Rs. 200s. a month for a married officer or Rs. 125s. for a bachelor) will also be granted. The officer appointed will be required to contribute to the Ceylon Planters' Provident Society at the rate of 10 per cent of salary to which the Board will contribute a similar amount. The appointment is non-pensionable. Home leave will normally be granted at the rate of eight months' leave for each four years and four months service in Ceylon. Travelling expenses in Ceylon will be payable at the rates allowed to officers of similar status in Ceylon Government Service. The appointment will be subject to confirmation after three years service in Ceylon.

Applications giving full details of previous training and experience and accompanied by copies of any published papers and the names of three persons to whom reference may be made, should be sent before September 30 to the Secretary, Ceylon Association in London, King William Street House, Arthur Street, London, E.C.4, from whom further particulars concerning the appointment may be obtained.

ROLAND V. NORRIS,
Director, Tea Research Institute of Ceylon.

CROWN AGENTS FOR THE COLONIES

COLONIAL GOVERNMENT APPOINTMENTS

Applications from qualified candidates are invited for the following post: Laboratory Technician required by the Government of Nigeria for the Veterinary Department for one tour of 18–24 months with possible permanency. Salary according to age and war service in the scale £400 rising to £600. On salary of £400 local allowance of £60 a year is payable. Separation allowance on same salary is between £84 and £204 according to number of dependants. Outfit allowance £60. Free passages and quarters. Candidates not over 35, must be fully trained and experienced in modern laboratory technique. Knowledge of the care of small laboratory animals desirable. Preference given to members or associates of the Institute of Medical Laboratory Technology.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience to the Crown Agents for the Colonies, 4 Millbank, London, S.W.1, quoting M/N/16836 on both letter and envelope.

MINISTRY OF HEALTH

ENGINEERING INSPECTORS

Applications are invited by the Ministry of Health for about twelve vacancies as Engineering Inspector. Age limits 35–50 on July 1, 1946. Candidates must be Chartered Civil Engineers. Special consideration will be given to candidates with an honours degree in engineering. In general candidates must have wide experience in the design of Water Supply Works and/or sewerage and sewage disposal works in addition to general civil engineering; but there is one vacancy requiring wide experience in Mechanical and Institutional Engineering, and one requiring wide experience in Public Cleansing, Refuse Disposal and Salvage and Recovery Work. The scale of salary is £1,100 × £30–£1,300 × £50–£1,400 (London); somewhat lower in the provinces. The minimum of the scale will be linked to age 40 with deductions below that age of £30 per annum. Most of the officers appointed will be stationed in London although some may be stationed at the Ministry's Regional Offices in the provinces. Further particulars and forms of application may be obtained from the Establishment Officer, Ministry of Health, Whitehall, London, S.W.1, or from the Chief Officer, Civil Service Commission, at the following addresses: (India) 10 Underhill Lane, Delhi; (Egypt) 9 Sharia El Birgas, Cairo; (Italy) c/o Headquarters, No. 3 District, C.M.F.: (Germany) c/o Second Echelon, G.H.Q., B.A.O.R. Completed application forms must be returned to the Ministry of Health not later than September 14, 1946 (for candidates in the United Kingdom) or October 12, 1946 (for candidates overseas). Service candidates may apply without regard to the date of their release in Class A.

SUDAN GOVERNMENT

The Department of Agriculture and Forests requires the services of Four Inspectors of Agriculture, for service in the Sudan. The selected candidates, who must be between 25 and 45, will be required to serve in any part of the Sudan, and to undertake any duties which may be allotted to them in connexion with the work of the Department, including the training of Sudanese staff. Candidates must have had a thorough practical training in agriculture and should preferably, but not essentially, be holders of a University Degree or College Diploma in agriculture. Appointment will be on short term contract (initially for two years) without post service benefits, or on Provident Fund Contract (with security for seven or more years after a probationary period of two years). Starting salary will range between £E.600–£E.900 for short term contract and £E.500–£E.840 for Provident Fund contract. (£E.1 equals £1 0s. 6d.) Starting salary will be fixed according to age, qualifications and experience. An outfit allowance at the rate of £E.60 is payable on appointment provided salary does not exceed £E.700 on Provident Fund contract and £E.800 on short term contract. Free passage to the Sudan. Strict medical examination. A cost of living allowance at the rate of 35 per cent of pay is payable, subject to a maximum of £E.15 per mensem on salaries up to £E.1,200. At present there is no income tax payable in the Sudan.

Papers containing full information for candidates are obtainable from the Sudan agent in London, Wellington House, Buckingham Gate, London, S.W.1. Envelopes to be marked "Inspector of Agriculture."

SHORT SERVICE COMMISSIONS IN THE ARMY EDUCATIONAL CORPS

Short service commissions (periods 3, 4 or 5 years) are to be granted in the Army Educational Corps. Those who have no previous military educational experience must have a degree of a British University or be entitled to recognition as "qualified" teachers. There are no age limits, but the majority of appointments will be filled by applicants about 25 years of age. As an example of the emoluments, a single man of 25 years of age with a degree and 2½ years teaching experience will draw pay at £310 a year or if he has a second class honours degree £347 a year or if he has a first class honours degree £420 a year, in all cases plus free furnished accommodation and rations. If he is married, he receives £228 marriage allowance in addition to his pay, and ration allowance. Tax free gratuities of £337 10s., £450 and £562 10s., are payable at the end of 3, 4 and 5 year periods respectively. The Ministry of Education has agreed to recognize service in the Army Educational Corps in suitable cases. Those granted short service commissions will be eligible for selection for permanent commissions.

Apply to the U.S. of S. for War, (B), War Office, A.E. (1), 45 Eaton Square, London, S.W.1, for further information and for application forms.

NEWFOUNDLAND GOVERNMENT LABORATORY

Applications are invited for the following fisheries research posts in the Newfoundland Government Laboratory :

(1) Senior Chemist—Candidates should possess Doctor's degree in Chemistry and have had experience in research on fisheries products. Salary $5,000 rising by annual increments of $200 to $6,000, or $4,000 rising by annual increments of $100 to $5,000, according to experience and ability.

(2) Chemist—Candidates should possess good qualifications in Chemistry with post-graduate experience. Salary $3,000 rising by annual increments of $100 to $4,000.

(3) Marine Biologist—The post involves research on one or more of the ground fishes and also some hydrography. Candidates should be able when necessary to carry out biological and hydrographical work at sea. Salary $3,000 rising by annual increments of $100 to $4,000.

All posts are non-contributory pensionable posts in the Newfoundland Civil Service. Further particulars can be obtained on request. Applications, stating age, qualifications, experience and the names of two or three references, should be sent to the Director, Newfoundland Government Laboratory, St. John's, Newfoundland.

LEEDS COLLEGE OF TECHNOLOGY

PRINCIPAL: C. CHEW, M.Sc.TECH., F.R.I.C.

DEPARTMENT OF CHEMISTRY

Applications are invited for the post of full-time Lecturer in the above department, duties to commence in January 1947.

Candidates should possess a good honours degree of a British university, together with teaching and industrial experience. The selected candidate will be required to teach mainly Inorganic with some Physical Chemistry. Salary according to the Burnham Scale.

Further particulars and form of application, to be returned within three weeks of the appearance of this advertisement, will be forwarded on receipt of a stamped addressed foolscap envelope.

GEORGE GUEST,
Director of Education.

Education Offices,
Leeds, 1.

THE ROYAL INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND 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 positions, is kept at the office of the Institute. The facilities afforded by this Register are available (free) to Companies and Organizations requiring the services of chemists, and to Universities, Colleges and Technical Schools requiring Teachers of Chemistry and Technology.

Particulars of the Regulations and Examinations of The Institute can be obtained (free) on application to The Registrar, the Royal Institute of Chemistry, 30, Russell Sq., London, W.C.1.

THE WEST OF SCOTLAND AGRICULTURAL COLLEGE

The Governors invite applications for the following posts. Forms of application, obtainable from the undersigned, should be lodged not later than September 19, 1946.

(1) Assistant Lecturer in Zoology: Applicants should have special qualifications in Entomology or Helminthology. Salary (as from October 1 next) £385 × 25–680 per annum plus appropriate consolidation addition £78 (at minimum of scale).

(2) Junior Assistant Lecturer in Chemistry: Applicants should be interested in Botany or Plant Physiology. The post involves chemistry of foliar diagnosis and lecturing to chemistry students. Salary (as from October 1 next) £265 × 25–385 per annum, plus appropriate consolidation addition £78 (at minimum of scale).

(3) Second Junior Assistant Lecturer in Chemistry: Salary (as from October 1 next) £210 × 18–385 per annum.

N. B. BAIN,
Secretary.

Blythswood Square,
Glasgow.

UNIVERSITY OF BRISTOL

The University invites applications for a Lecturer in Geography. Salary £400 to £600 p.a., according to qualifications and experience.

Applications should reach the undersigned, from whom further particulars may be obtained, not later than September 20, 1946.

WINIFRED SHAPLAND,
Secretary and Registrar.

MIDDLESBROUGH EDUCATION COMMITTEE

CONSTANTINE TECHNICAL COLLEGE

Applications are invited for appointment as full-time Laboratory Stewards in the Engineering and Pure Science Departments of the College (three vacancies), to commence early in September. Candidates must have had a good practical training in industry or in a technical unit of H.M. Forces, and have technical knowledge of Engineering, Chemistry or Physics, up to Inter.B.Sc. or Ordinary National Certificate standard.

Salary scale £255 × 15 — £300 plus cost of living bonus (at present £60 per annum). Application forms and further information obtainable from the undersigned, to whom the completed forms should be returned as soon as possible.

STANLEY HIRST,
Director of Education.

Education Offices,
Middlesbrough.

UNIVERSITY COLLEGE OF NORTH WALES, BANGOR

Applications are invited for appointment as Temporary Scientific Assistant (Male) in the Department of Zoology for experimental research on prenatal fertility in mammals, with the aid of a special research grant from the Agricultural Research Council. Candidates should have a degree in Zoology or Physiology. Salary from £255 p.a., plus war bonus, according to age and experience. The appointment is from September 16 or as soon as possible thereafter.

Applications should be sent to the undersigned as soon as possible.

GLYN ROBERTS,
Secretary and Registrar.

UNIVERSITY OF ABERDEEN

LECTURESHIP IN ENGINEERING

Applications are invited for a Lecturer in Engineering. Candidates will require to have a good Honours Degree in Engineering and some practical experience, including surveying. Salary £500–£600 according to qualifications and experience. In addition a children's allowance of £50 per annum for the first child and £40 per annum for each subsequent child under 16, or while the child is undergoing full-time education, is payable.

Applications should reach the Secretary to the University (from whom forms of application and conditions of appointment may be obtained) not later than September 28, 1946.

H. J. BUTCHART,
Secretary.

The University,
Aberdeen.

THE UNIVERSITY OF SHEFFIELD

The University intends to fill as soon as possible in 1946–47 the Chair of Fuel Technology which has been vacant since the death of Professor R. V. Wheeler in 1939, the Department having meanwhile remained in action. Long previous industrial experience is not essential, but proved power in original and modern investigation is, especially in the physics or physical chemistry of fuel and combustion. The salary will be not less than £1,450, with superannuation provision under the Federated Superannuation Scheme for Universities and with family allowances. Further information can be obtained from the undersigned, with whom those who may become candidates are invited to communicate not later than October 1, 1946.

A. W. CHAPMAN,
Registrar.

HERIOT-WATT COLLEGE EDINBURGH

Lecturer in Botany with, preferably but not essentially, a subsidiary qualification in chemistry or biochemistry. Salary scale £400–£15–£595. Applications would also be considered from suitably qualified persons able to give part-time service only. Further particulars may be obtained from the Principal, to whom application should be made as soon as possible.

J. C. SMAIL,
Principal.

UNIVERSITY OF DURHAM

KING'S COLLEGE, NEWCASTLE UPON TYNE

DEPARTMENT OF ZOOLOGY

The Council of King's College invite applications from women graduates for the post of Lecturer in Zoology at a commencing salary of not less than £450, rising by annual increments of £25 to a maximum of £800.

Ten copies of application, which should include the names of three persons to whom reference may be made, should be sent not later than October 12, 1946, to the undersigned from whom further particulars may be obtained.

G. R. HANSON,
Registrar of King's College.

DERBY TECHNICAL COLLEGE

NORMANTON ROAD, DERBY

Applications are invited from graduates of a British University for the post of Full-time Lecturer in Physics, to commence duties in January, 1947, or earlier. Salary will be in accordance with the report of the Burnham Committee, 1945, with allowances for approved training, research or industrial experience.

Further details and forms of application may be obtained from the Principal, Dr. W. A. Richardson, O.B.E., to whom they should be returned by September 23, 1946.

SCIENTIFIC ADVISER, PARIS

The British Council invites applications for the post of Scientific Adviser in Paris. Salary not less than £700 per annum according to qualifications, plus living allowances. Applicants should be of good scientific standing. The ability to speak French is essential. Preference will be given to applicants at present engaged in scientific research and able to spend a limited period abroad. The Adviser appointed would be concerned in promoting Anglo-French scientific relations. Appointment is for a period of one year in the first instance.

Applications, stating age, experience and qualifications, should be addressed to the Director, Appointments Department, The British Council, 3 Hanover Street, W.1, marking the envelopes "Science, Paris."

UNIVERSITY OF ABERDEEN

LECTURESHIP IN CHEMISTRY

Applications are invited for a Lecturer in the Department of Chemistry. Candidates should have special qualifications in organic chemistry. Salary £500–£900, placing according to qualifications and experience. In addition a children's allowance of £50 per annum for the first child and £40 per annum for each subsequent child under 16, or while the child is undergoing full-time education, is payable. Applications should reach the Secretary to the University (from whom forms of application and conditions of appointment may be obtained) not later than September 2, 1946.

H. J. BUTCHART,
Secretary.

The University,
Aberdeen.

UNIVERSITY OF BIRMINGHAM

FACULTY OF SCIENCE

PROFESSORSHIP OF MINING

Applications are invited for the Chair of Mining, which includes both coal mining and metalliferous mining. Applicants should have had engineering training and experience of research, and should be fully qualified mining engineers with special knowledge of coal mining. The salary offered is £1,650 per annum.

Three copies of the application, together with the names of three referees, should be sent before October 1, 1946, to the undersigned, from whom further particulars can be obtained.

C. G. BURTON,
Secretary.

The University,
Edmund Street, Birmingham, 3.

UNIVERSITY COLLEGE OF SWANSEA

Applications are invited for the post of Lecture Assistant in the Department of Chemistry. Applicants should have had previous experience and possess some skill in glass-blowing. Wages £5, rising to £6 per week. Applications, stating age and experience, should be forwarded to the Registrar, University College, Singleton Park, Swansea, by September 14, 1946. Further particulars concerning the post may be obtained from the Registrar.

UNIVERSITY OF BIRMINGHAM

FACULTY OF SCIENCE

CHAIR OF ELECTRICAL ENGINEERING

The Council invites applications for the Chair of Electrical Engineering. The stipend offered is £1,650 per annum. It is desired that the applicant should take up his duties as soon as possible, and not later than January 1, 1947. Six copies of the application, together with the names of three referees, should be sent before November 1, 1946, to the undersigned, from whom further particulars may be obtained.

C. G. BURTON,
Secretary.

The University,
Edmund Street, Birmingham, 3.

THE SIR JOHN CASS TECHNICAL INSTITUTE

JEWRY STREET, ALDGATE, E.C.3

Applications are invited for appointments as (1) Lecturer in Physics, (2) Lecturer in Mathematics, (3) Lecturer in Chemistry. The work is of University standard and there are facilities for research. Salary in accordance with the Burnham (Technical) Scale for London. Details can be obtained from the Principal, to whom applications should be sent as soon as possible.

THE POLYTECHNIC

REGENT STREET

DEPARTMENT OF MATHEMATICS AND PHYSICS

Courses of lectures on elementary and advanced Mathematical Statistics, designed to meet the needs of scientists and engineers, will commence on Wednesday, October 2, 1946.

Full particulars may be obtained on application to the undersigned.

J. C. JONES,
Director of Education.

The Polytechnic,
309 Regent Street, London, W.1.

BRITISH IRON AND STEEL RESEARCH ASSOCIATION

The above Association has a vacancy for a Physicist in the Senior Scientific Officer Grade as head of the General Physics section of the Physics Department, to work on the relations between the various physical properties of liquid and solid steel. An honours University degree in Physics essential, a higher degree an advantage. Age range 28–38. Salary £600 to £800 per annum according to age, qualifications and experience. All appointments are superannuated under the F.S.S.U. Written application only giving full curriculum vitae to be sent to the Personnel Officer, The British Iron and Steel Research Association, 11 Park Lane, W.1.

The Civil Service Commissioners

invite applications for appointment as Director of Research in a research organization to be established jointly by the Department of Scientific and Industrial Research and the Fire Offices' Committee, for the conduct of research on all aspects of prevention and extinction of fire, the safety of life in fire and mitigation of damage. Candidates should have high academic or professional qualifications and should have extensive experience of research, of the planning of research programmes, of the supervision of research teams and of the presentation of the results of research to meet the needs of different users. The general nature of the research involved is such that candidates with basic training, qualifications and experience in Physics, Chemistry or Engineering would be most suitable, but it is not desired to exclude others who consider they have special qualifications for the post. The Headquarters of the Director are expected in the first instance to be in London, but may eventually be removed out of London. The salary scale for London is £1,600–£1,800 by increments of £50 p.a. This scale would be subject to a deduction of £50 or £100 on transfer of the Headquarters according to its location. Superannuation provision will be made under the Federated Superannuation System for Universities. Candidates must be of British nationality.

Further particulars and application forms may be obtained from the Civil Service Commission, 6 Burlington Gardens, London, W.1, quoting No. 1620, with whom completed applications must be lodged by September 30, 1946.

Applications are invited from qualified

Dietitians for appointment as Senior and Junior Dietitians in the Scientific Adviser's Division of the Ministry of Food.

Senior Dietitians. Candidates should possess a science degree or Domestic Science teacher's diploma and diploma in dietetics. Salary: (according to qualifications and experience) £320 to £480 p.a. plus a consolidated addition of £72 p.a.

Junior Dietitians. Candidates should possess a science degree or a Domestic Science diploma. Salary: (according to qualifications and experience) £275 to £320 p.a. plus a consolidated addition of £63 to £72 p.a.

All candidates appointed will be required to carry out nutritional studies of food consumption in different parts of the country, to deliver lectures, and to prepare and edit material to be used in forwarding the Ministry's nutrition policy.

Write quoting F.4631 to Ministry of Labour and National Service, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, for application forms which must be returned completed by September 27, 1946.

An experienced Technical Writer re-

quired by a London company for the preparation of advertisements, catalogues and operating manuals for industrial and scientific equipment concerned with instruments, electronics and physical apparatus. Applicants should have the requisite technical background and be capable of handling the firm's publicity work, but applications are invited from young men who, otherwise suitable, could assume fuller responsibility for the latter duty after experience with the company. A permanent and progressive post offering excellent opportunities for a first-class man. Address, marked "Confidential," giving full details of experience, qualifications, salary expectations, etc., to Box 681, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

(*Continued on page* iv *of Supplement.*)

(*Continued from page* iii *of Supplement.*)

Applications are invited for the post of Director of the West African Institute of Tsetse Fly and Trypanosomiasis Research. The appointment will be for a period of not less than five years with a salary, according to qualifications, of not less than £1,600 per annum : free quarters and passages to and from West Africa will be provided : and arrangements will be made to safeguard superannuation rights by the payment of the existing employer's pension contribution to any superannuation scheme.

The West African Institute is to be established at an early date. Its function will include research on all aspects of Trypanosomiasis, human, animal and entomological : testing of new therapeutic, insecticidal and other compounds : investigation into technique of field survey and reclamation ; training of staff. An early appointment of a Director is essential as he will be closely associated with the siting and establishment of the new Institute.

Applications, which should be submitted before October 30, 1946, should be addressed to the Director of Recruitment, Colonial Office, Victoria Chambers, 15 Victoria Street, London, S.W.1.

Applications are invited for the appointment of a Research Assistant required for work on flow of fluids in porous materials, with particular reference to land drainage.

Applicants should possess an honours degree in physics or engineering, and should preferably have had some research experience. The salary payable is in the range of £450–£550 a year.

Applications, together with copies of not more than three recent testimonials, should be sent to the Secretary, School of Agriculture, Cambridge, not later than September 30, 1946.

Science graduates in any scientific field, preferably with research experience, are required for the Research Staff of a Government Social Survey Organization. The additional requirements are an interest in social problems and development and in the application of scientific method to the collection and analysis of social data. All the work is of immediate national importance and affords opportunity for the working out of new techniques of fact-finding in the social field. Apply in writing to Box No. 1282, c/o Charles Barker & Sons, Ltd., 31, Budge Row, Cannon Street, London, E.C.4.

Engineer required for Research and Development work on extrusion moulding. Applicants should be fully qualified, preferably with B.Sc. (Eng.). Previous experience desirable but not essential. Age 25–30. Apply : Personnel Dept. (PM/LVG/37), Dunlop Rubber Co., Erdington, Birmingham.

Draughtsman required, fully qualified, for Engineering Development Department. Experience in layout of moulding and extrusion equipment desirable but not essential. Apply : Personnel Dept. (PM/LVG/38), Dunlop Rubber Co., Erdington, Birmingham.

King's College, London, will require in October or as soon thereafter as possible an Assistant Lecturer in Zoology. Salary £400. There is also a vacancy for a Tutorial Student in Zoology. Emolument £300. Particulars and forms of application may be obtained from the Secretary, King's College, Strand, W.C.2, and completed forms, accompanied by three copies of two recent testimonials should reach him not later than September 23, 1946.

Physicist, with some general knowledge of manufacturing in various branches of Electrical Engineering, required by large organization. Knowledge of patent procedure an advantage. Applicants should write giving fullest details of qualifications and previous experience, also stating age and salary required to Box 680, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Two glassblowers required for laboratory in South West London area. One for skilled routine and one for wide variety of work. At least two years' glassblowing experience. Write stating age, experience, qualifications, wage, etc., to Box No. 108, L.P.E., 110 St. Martin's Lane, W.C.2, quoting ref. "M.I."

The Royal Society of New Zealand invites applications for the T. K. Sidey Summer Time Award of a Bronze Medal and a prize of £100. The Award is made for scientific research on any kind of electro-magnetic radiation (visible or invisible), including its relation to human welfare.

Applications close January 31, 1947. Information may be obtained from the Secretary, The Royal Society of New Zealand, Victoria University College, Wellington, New Zealand.

The University Court of the University of St. Andrews invites applications for the post of Lecturer in the Department of Bacteriology in the Medical School, Dundee. Salary £400 p.a. with superannuation provision and an additional payment of £50 p.a. for special duties. Applications will be considered from candidates in H.M. Forces. Applications with copies of two recent testimonials and the names of two referees, to be submitted to the undersigned, from whom a statement of conditions of appointment may be obtained. Closing date November 16, 1946.

DAVID J. B. RITCHIE,
Secretary, The University, St. Andrews.

Scott Polar Research Institute, Cambridge. Applications are invited for the post of Librarian. Preference will be given to an applicant with scientific experience and able to prepare abstracts for publication. Scandinavian languages and German desirable. Salary £250–£400. Applications to Director, from whom further details can be obtained.

Lecturers having a sound knowledge of biology and/or physiology, resident in Northern Ireland and willing to lecture occasionally on some aspect of Health Education, are required by the Central Council for Health Education. Honorarium £2 2s. per lecture, plus first class travelling and maintenance. Further particulars and a form of application can be obtained from Robert Sutherland, M.D., D.P.H., Medical Adviser and Secretary, Central Council for Health Education, Tavistock House, London, W.C.1.

Required by large radio firm S.W. London area, graduate physicist, under 30 years, required to devise and carry out electrical tests as member of a research team working on electrical properties of solids. Write with full particulars of qualifications, previous experience, age and salary required to Box No. 101, L.P.E., 110 St. Martin's Lane, W.C.2, quoting ref. "M.I."

A position is offered in the laboratories of a food firm for an assistant chemist with B.Sc. or equivalent to study the development of a new type of food product in the laboratory and on pilot scale plant. An interest in organic chemistry is desirable. Salary about £300 p.a. Reply Box 1,800, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

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the greatest remaining wood reservoir in the world, they produce a great assortment of non-timber and food products. The Organisation is the only existing body that can influence Governments to develop sound policies for their utilization, thus avoiding a repetition of the wasteful exploitation that has so often occurred in the past. To this end a world forest policy is urged, such as has already been considered by the Interim Commission. Besides the direct value of the timber, good forest management has far-reaching beneficial effects. Afforestation can reclaim swampy land, prevent soil erosion, and, provided grazing is controlled, may be an asset in the raising of livestock ; in fact, over large areas afforestation is a pre-requisite to better agriculture and improved rural living standards.

Up to the present, there has been no world-wide organisation of fisheries, and the collection of information regarding world production and markets and the setting up of statistical surveys are pressing demands on the Food and Agriculture Organisation. Normally more than ninety per cent of the world's fish is caught in the North Atlantic and North Pacific Oceans, but, during the War, fishing grounds have been developed by South American countries and could probably be extended elsewhere. Freshwater fish, too, might be a valuable asset in districts where livestock industries cannot easily be developed and the diet is likely to be deficient in protein. Conservation measures are of importance in the old fisheries, and in view of the varied nature of the problems in the different areas, it is suggested that international action should be established on a regional basis.

Marketing affects all commodities, and the economic adjustment of international markets is perhaps the most crucial problem that confronts the Food and Agriculture Organisation. The under-developed countries need advice and help on the technical side of modern marketing, whereas simplification in methods of distribution is the prior call in the more advanced countries. Measures for international co-operation on matters of food infestation, standardization of grades, nomenclature, etc., will need working out, and machinery designed to deal with shortages and surpluses. The improvements in methods of processing and storage developed during the War should prove of particular benefit in the latter case.

In all these fields statistics form an essential background, and there is urgent need for the continuation and extension of international records relating to agriculture, forestry, fisheries and food consumption. Uniformity in definition of terms, together with the use of comparable techniques for the collection of data, are urged, and the formation of a central statistical unit servicing all the activities of the new Organisation is suggested.

The need for a central library, or possibly of several regional libraries, is evident, and it is hoped that the agricultural library of the International Institute of Agriculture will be available as a nucleus for the Food and Agriculture Organisation.

The documents and resolutions appended to the report are impressive evidence of the work of Commission B. They comprise a set of rules of procedure, a set of permanent and temporary financial regulations, and a budget for the first two financial years. On this Commission's recommendation, the Conference decided to continue the temporary seat of the Organisation at Washington, and to establish the permanent seat at that of the United Nations, assuming that this would also be the seat of the Economic and Social Council.

In signing the constitution of the Food and Agriculture Organisation, governments have undertaken to make periodic reports to the director-general on progress achieved in the fields of nutrition, agriculture, forestry, fisheries and rural welfare. These will provide the information from which further advice and recommendations can be given—in fact, the Organisation will be useful to the extent which it is used. In the words of the chairman, "The first of the new permanent United Nations agencies is now launched. . . . The Conference hopes that it will likewise be first in energy and in usefulness, so that it may make the maximum contribution possible to healthier and more abundant life, and to a peace built on day-by-day, practical co-operation among the peoples of the world."

NEWS and VIEWS

Prof. R. T. Leiper, C.M.G., F.R.S.

THE title of emeritus professor of helminthology has been conferred by the University of London upon Prof. R. T. Leiper, who is retiring from the William Julien Courtauld chair of helminthology. When he went to the London School of Tropical Medicine (which later amalgamated with the London School of Hygiene) Leiper set himself to organise the courses of instruction in helminthology which have been so valuable to medical men taking postgraduate courses and to others who have been able to attend them. Leiper was also director of the Institute of Agricultural Parasitology at Winches Farm, St. Albans. To his inspiration and wise guidance we are largely indebted for the series of researches done at this Institute upon the nematodes which do so much harm to valuable crops and also upon the nematodes and other helminths which attack farm animals. Winches Farm, now well known wherever parasitology is studied, is also the home of the Imperial Bureau of Agricultural Parasitology, the services of which to research workers and to others can scarcely be under-estimated. Leiper also founded and edited the *Journal of Helminthology*, which was, until it became necessary, during the recent War, to discontinue it, one of the very few British journals devoted entirely to parasitology. Prof. Leiper's own researches take us back some forty years, when he began to publish the long series of papers in which his work is recorded. Outstanding among these papers is the record of his work on the life-histories of the human blood-flukes, *Schistosoma hæmatobium* and *S. mansoni*. When Japanese workers worked out the life-history of *Schistosoma japonicum*, which causes human schistosomiasis in Japan and adjacent areas, Leiper set to work in Egypt and demonstrated that *S. hæmatobium* and *S. mansoni* are different species, which employ as their intermediate hosts different species of snails. He thus laid the biological foundation of our present extensive know-

ledge of the biology and control of the forms of schistosomiasis caused by these two species of *Schistosoma*. Throughout his tenure of the Courtauld chair of helminthology, Prof. Leiper's advice and help were continually sought and generously given. He was a member of many committees and advisory bodies and exercised, as an adviser to these and to the Agricultural Research Council and other Government organisations, a widespread influence.

British Electrical and Allied Manufacturers' Association : Mr. Bruce H. Leeson, O.B.E.

Mr. Bruce H. Leeson, managing director of A. Reyrolle and Co., Ltd., has been appointed director of the British Electrical and Allied Manufacturers' Association as from October 1, in succession to Mr. V. Watlington. Mr. Leeson was responsible for the formation of the Technical and Research Department of Messrs. Reyrolle, with particular reference to the switchgear and protective gear upon which that firm specializes. He was intimately connected with the establishment of the first short-circuit testing station in Britain in 1929, and afterwards with the standardization of switchgear performance, and the formation of the Association of Short-Circuit Testing Authorities and the negotiations with the National Physical Laboratory, under the auspices of which it operates. Mr. Leeson has been actively interested in establishing anew the north-east coast of England as a development area for industry. Since their inception, he has taken a practical executive interest in three important local bodies : the Northern Industrial Group, which encourages industry and employment in the whole district ; the North-East Development Association, which co-ordinates all efforts for the benefit of the area ; and the North-East Engineering Bureau, which aims at progress in light and allied engineering.

British Iron and Steel Research Association : Dr. M. L. Becker

Dr. M. L. Becker, chief metallurgist to the Gear and Tool Divisions of Messrs. David Brown and Sons (Huddersfield), Ltd., has been appointed superintendent metallurgist to the British Iron and Steel Research Association. Previously he was on the staff of the National Physical Laboratory. Dr. Becker studied at the Universities of Sheffield and Manchester, and for a time was with the British Cast Iron Research Association. He has been closely associated with the iron and steel industry, having undertaken research on gaseous equilibria, alloys of iron, spring steels, materials for high-temperature service and many allied problems. Latterly his interests have been primarily in the use of steels and alloys in engineering, and in this connexion he has been concerned with the development of works processes of gas carburizing and of flame and induction hardening.

National Coal Board : Chief Mining Engineer

The National Coal Board has appointed Prof. Douglas Hay to be chief mining engineer to the Board. Prof. Hay is president of the Institution of Mining Engineers and honorary professor of mining in the University of Sheffield. He is at present managing director of Barrow Barnsley Main Collieries, Ltd., and the Barnsley District Coking Company, Ltd., also technical director of the Wombwell Main Company, Ltd. He was H.M. Inspector of Mines for Durham and North Staffs during 1920–22 ; and professor of mining in the University of Sheffield during 1922–25. He has been consulting engineer on ventilation of the Mersey Tunnel (1929–37) and Dartford Tunnel since 1937.

Roman Remains in Exeter

Results of exceptional interest for the study of Roman Britain have been obtained by the Committee excavating on war-damaged sites in the city of Exeter. The work has been carried out under the direction of Lady Fox. According to a preliminary report (*The Times*, August 21) two houses of the period of the first occupation by the Romans of what is now Exeter were discovered in ground to the east of the Lower Market. They were built in a framework of wooden uprights, six inches in diameter, and driven deeply into the ground. These two structures stood one on either side of a narrow metalled roadway with a central channel to carry off surface water to the Exe. It was possible to construct a nearly complete plan of one of the houses, which showed that it had consisted of one large room, 36 ft. by 22 ft., an adjoining kitchen or work chamber and a narrow annex. The floor of the principal room was of clay, which had been kept sanded ; the walls were probably of horizontal boarding or of wattle and daub. There was a fireplace of red tiles in the centre. In the annex were Samian and pre-Flavian pottery, which fix the date at *circa* A.D. 55–75, and mingled with these, fragments of coarse native ribbed ware which point to the persistence to this relatively late date of an early Iron Age ware—a somewhat remarkable survival. At about A.D. 80 these buildings were demolished to make an open space, thought to have been the court of the Forum. The importance of this part of the Committee's results will readily be appreciated since they will help very considerably to throw light on the little-known urban life at this early stage of the Roman occupation.

Archæological Work in Southern Mexico

After four months of field work near San Lorenzo, Veracruz State, in southern Mexico, on the third of a group of important centres of the La Venta culture, a joint archæological expedition of the National Geographic Society and the Smithsonian Institution, led by Dr. Matthew W. Stirling, has returned to Washington. The season's activities mark the conclusion of eight years of work by Dr. Stirling. The inquiries began in 1939 with the uncovering of a huge basalt sculpture in the form of a human head, near Tres Zapotes, a village in Veracruz State. The site proved to have been a ceremonial centre marked also by earthen mounds. One of the most important discoveries during the series of expeditions was made at Tres Zapotes in 1939—an inscribed stela bearing in Mayan characters the earliest recorded date, believed to be contemporary, so far brought to light in the western hemisphere. The date has been interpreted as 291 B.C. according to the Spinden correlation or 31 B.C., Thompson correlation. In the following year, Dr. Stirling and his associates began excavations at the site of La Venta, Tabasco, so rich in monuments and artefacts that it has given its name to the newly discovered culture. La Venta, unlike the other two ceremonial centres, was a place of burial for important personages among the La Venta people. The San Lorenzo site, worked in 1946, is the farthest inland of the three sites excavated. It lies about sixty miles from the Gulf of Mexico on the Rio

Chiquito. It is also the most extensive of the centres, and there, apparently, the sculpture of the La Venta culture reached its highest development. The five huge heads discovered are for the most part better made, better preserved, and bigger than those from the other locations. Some of the heads are nearly ten feet high and are estimated to weigh more than twenty tons. It seems that the La Venta culture at Tres Zapotes started about A.D. 300 and lasted there until about A.D. 1000. The La Venta and San Lorenzo sites apparently were developed later and abandoned earlier. The correlation of art forms and pottery types points to the probability that the La Venta culture was a forerunner of much of the culture of the Mayas, the Toltecs and the Aztecs.

Prehistoric Studies in Austria during the War Years

THE war-time "Mitteilungen des Prähistorischen Kommission der Akademie der Wissenschaften, Wien" are now to hand. There are five reasonably stout volumes and one (1942) much reduced. They cover the years 1939–44 inclusive. The first volume, the work of A. Hild, is concerned with the grave finds from Bludenz (Vorarlberg), which date from about 1000 B.C. and after. As always in the case of these publications, there are a number of excellent illustrations at the end of the volume. Adam Graf Orssich de Slavetich describes, in the 1940 volume, a site called Bubanj near Nish (Jugoslavia). Here the finds are somewhat earlier in date and can be compared with the early Vinča material. Some of the illustrations of the pottery are in colour, and there is a map. In the 1941 volume, E. Beninger deals with an early Bronze Age site at Gros-Mugl, Niederdonau, while the short 1942 volume (by Christian Pescheck) describes a late Hallstät find from Donnerskirchen, Niederdonau. The 1943 volume deals with grave finds of a similar date from Krensdorf and is by J. Tomschik, while the last volume (1944) is concerned with early Metal Age tumulus finds at Mühlhart, near Fürstenfeldbruck, Upper Bavaria. It is good news to learn that archæological interest in Austria was not quite dead throughout the war years. The volumes noted above are, of course, important for all students interested in the archæology of the periods covered.

Guide to Cultural Materials

WHEN visiting outlying parts of the world, it sometimes happens that opportunity arises to study a folk who are still in a primitive stage of culture, whose ideas, social customs and implements are very different from what we are used to see among more civilized races. In order to make good use of such an opportunity, it is necessary to know in advance what to look for and what questions to ask, so that the maximum amount of information can be obtained. Vol. 2 of the Yale Anthropological Studies entitled "Outline of Cultural Materials" (New Haven: Yale Univ. Press; London: Oxford Univ. Press. 6*s*. 6*d*. net), which has been prepared by G. P. Murdock, C. S. Ford, A. E. Hudson, R. Kennedy, L. W. Simmons and J. W. M. Whiting, sets out under various headings and in convenient form just what is needed in this respect. An index is appended.

Antiquity of Man

PROF. H. BREUIL has recently delivered the Huxley Memorial Lecture of the Royal Anthropological Institute for 1941 (from the Institute, 2*s*. 6*d*.). The delay, of course, was consequent on the War. His subject was "The Discovery of the Antiquity of Man". A useful historical retrospect occupies several pages, after which the geological and palæontological situation is considered. Prof. Breuil has not attempted to bring forward new matter; but stands back, as it were, for a moment and takes stock of the edifice of knowledge on this subject already erected.

Coal Gas and Fuel Industries at the University of Leeds

HEALTHY collaboration between a university department and industry is recorded in the report of the Livesey professor (Dr. D. T. A. Townend) on the work of the Department of Coal Gas and Fuel Industries, University of Leeds. There are now, in the Department, eighty-four undergraduate and post-graduate students catered for by a teaching staff of ten. In addition, there are twenty-one research fellows and assistants provided by the Joint Research Committee of the University of Leeds and the Gas Research Board, the Alloy Steels Research Committee, the Department of Scientific and Industrial Research and other Government departments. It is impossible in chemical engineering and many other branches of applied science to conduct research entirely in the laboratory; full-scale or semi-scale plant must be used. It is always difficult, and often impossible, to provide such plant in universities. If these sciences are to prosper in Great Britain, university departments must be given facilities by industry. Prof. Townend has been most successful in obtaining the necessary access to industrial plant. Experiments have been carried out on semi-scale plant, at works of the Bournemouth Gas and Water Co., on the gasification of coal in hydrogen at high pressures and temperatures. Preparations have also been in progress at Bournemouth for large-scale testing at high and normal pressures of the control techniques, devised in the laboratory, involved in the synthesis of methane from carbon monoxide and hydrogen. Semi-scale plant has also been installed, for other purposes, at the Leeds gasworks. The rapid expansion in the work of the Department has, in addition, necessitated further laboratory facilities. The University had included in its post-war planning scheme provision for new buildings, and it is to be congratulated on the recent generous gift by Mr. Charles Brotherton of £55,000 for a new Chemical Engineering Laboratory. It is largely due to his help in this and other directions that a full chemical engineering curriculum has been put into effect so rapidly.

Agrarian Reconstruction in Italy

ANTONIO DONÀ DALLE ROSE has an article in *Ricerca Scientifica e Ricostruzione* (Rome) on this subject in which he summarizes and discusses the scope of the Italian-American Agrarian Convention, held at Florence during January 25–28. Among the proposals may be noticed the provision of a close collaboration among agrarian technicians—American and Italian—and it is pointed out that there would be a mutual advantage in such collaboration. In addition, there should be a close inquiry into the question relating to fundamental alterations in the agrarian industry with a view to an enhanced output. Finally, the bases of reconstruction should be clearly delineated. The subject is discussed at length in the article, and various suggestions are put forth under such headings as the necessity of American agriculture, the method of technical reconstruction and the economic position of Italian agriculture, animal

husbandry in relation to the problem of the shortage of forage, and various others. Finally, the delicate question of emigration is briefly referred to, and reference is made to a suggestion that there might be a large emigration of Italian workers into Latin America. Such emigration should be properly organised so that workers, technicians and directors of industry would find scope for their enterprise and be able to enjoy a full autonomous existence under the authority of the country receiving them.

Scientific Equipment made in Egypt

Dr. H. E. Hurst, of the Physical Department, Ministry of Public Works, Egypt (*J. Sci. Instr.*, 23, 134 ; 1946), has given a brief but interesting account of the 100,930 articles made for the British Army in the departmental workshop during the period September 1940–January 1946. The workshop, of moderate size, normally deals with the repair of scientific instruments and the occasional construction of research apparatus used in the study of the Nile. With machinery loaned by the British Army, the equipment of the workshop was doubled. Other machines for special purposes were improvised out of scrap. Ultimately, there were 120 workmen of all sorts working in a fairly well-equipped workshop. A list, giving the number and description of the articles accepted by the Army, includes sun compasses, protractors and scales, stereoscopes, slide rules, small tools and fuses.

American Philosophical Society : Year Book for 1945

The Year Book for 1945 of the American Philosophical Society, covering the year January 1, 1945–December 31, 1945, includes as usual the minutes of the meetings and of the executive sessions, together with the reports of standing committees, that on research containing classified reports from recipients of grants. Among these may be mentioned the following : R. N. Jones on factors influencing the ultra-violet absorption spectra of aromatic compounds ; E. J. Schremp on the fine-structure pattern of directional cosmic ray intensity ; S. Ochoa's studies on respiratory enzymes ; W. J. Eversole's investigation of the relation of carbohydrate-deficient diets to the effectiveness of hormones of the adrenal cortex ; H. J. Muller on age in relation to the frequency of spontaneous mutations in *Drosophila* ; S. McGregor Pady on the biology of *Melanosporella* ; R. Beutner and T. C. Barnes on a general explanation for the therapeutic action of the drugs which act on the nervous system ; R. P. Forster on the effect of general anæsthetics on renal function in the rabbit ; I. M. Korr on the relation between tissue metabolism and physiological activity and O. Meyerhoff's studies on intermediary enzymatic reactions of carbohydrate breakdown.

The feature of the report is the appreciation appended to the report of the Committee of the Library, on certain accessions during the year. These include an evaluation of thirty-three unpublished letters from Benjamin Franklin, written during the years 1753–67, by C. Van Doren, who is editing them for publication ; a detailed account of the C. W. Peale papers by Mr. C. C. Sellers, and a note by Z. S. Harris on American Indian linguistic work and the Boas Collection, which has now been transferred to the Library. Notes by W. E. Lingelbach on Franklin and the Lewis Evans Map of 1749, by F. Harper on proposals for publishing Bartram's "Travels" and by S. Adelman on equipping the Lewis and Clark expedition originated by Thomas Jefferson in 1801 help to give exceptional general interest to this annual volume.

Society for Psychical Research

The Society for Psychical Research has issued a pamphlet describing its work (31 Tavistock Square, London, W.C.1. Pp. 20. 3*d*.). It is not generally realized that the Society is a scientific society with a history of more than sixty years work. It originated with a distinguished group of trained thinkers in the University of Cambridge who were interested in the problem of those mental phenomena which appeared to fall outside the recognized laws of mental life. The Society sets out to examine phenomena of this class in a scientific spirit, and has during its existence collected and sifted evidence for and against : (1) the acquisition of knowledge without the use of the ordinary channels of sense, (2) communications purporting to come from the dead, (3) certain types of physical phenomena alleged to occur in the presence of a particular type of medium. The fact that some phenomena are apparently contradictory of recognized scientific laws is not in itself an adequate reason for thinking them to be unworthy of study. Already a considerable body of research exists concerned with telepathy, clairvoyance, the relation of such conditions to psychotherapy and the problems of survival. Modern methods of statistical analysis have proved of great value in the interpretation and arrangement of data. The Society is not concerned with mere trickery or trivial anecdotal evidence ; but aims at trying to understand, in the interests of truth, phenomena which, if eventually proved, will have an important bearing on our concept of personality.

Announcements

The British Association has arranged a Conference on London Traffic and the London Plan which will be held at the Institution of Civil Engineers, Great George Street, London, S.W.1, on September 12–13, when experts will speak on the general problems of traffic, town planning and architecture, and on the special problems of roads, railways, underground railways and travel by air. The Conference will be open free of charge to the public. Further details can be obtained from the office of the British Association at Burlington House, Piccadilly, London, W.1.

The Fuel Economy Conference of the World Power Conference will be held at The Hague during September 2–10, 1947. During this Conference, an official visit of two days will take place to the Netherlands State Coal Mines at Lutterade. Further information can be obtained from the British National Committee, World Power Conference, 36 Kingsway, London, W.C.2.

The Dunlop Rubber Co. is contributing £350 net per annum for seven years to the Department of Colloid Science in the University of Cambridge for research work on molecular structure. For the past two years the Department has been carrying out research work for the Dunlop Co. on the structure of natural and synthetic rubber molecules, and the changes occurring in vulcanization. The research will continue under the direction of Dr. G. B. B. M. Sutherland. The work under the new scheme will probably also include ultra-violet and ultra-short-wave radio technique.

LETTERS TO THE EDITORS

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

Circular Polarization of Solar Radio Noise

In two recent communications to these columns[1,2] we have reported the existence of powerful radio emissions in the 5-metre wave-length band from sunspot areas. Since such radio waves must travel through regions of considerable ionization in escaping from the sun, it occurred to us that the magneto-ionic theory of radio wave propagation[3], which has proved so useful in elucidating phenomena in the terrestrial ionosphere, would be applicable in the case of the corresponding solar envelope. According to this theory, characteristic polarizations are imposed on radio waves in their transmission through an ionized medium under the influence of a magnetic field, due either to differential absorption of the oppositely polarized magneto-ionic components or to the suppression of one component by electron limitation. Such effects are most pronounced if the radio wave frequency in question is either of the same order as, or less than, the electronic gyro-frequency determined by the imposed magnetic field. There is also the possibility that the noise itself has a magneto-gyric (electronic) origin.

Prompted by considerations of this kind, the state of polarization of solar radio noise was examined experimentally, on a frequency of 85 Mc./s., at the Operational Research Group Station of the Ministry of Supply during the recent period of sunspot activity (July 27 and 28, 1946). The polarization was, on that occasion, found to be circular, and of left-handed sense (viewed looking forward along the direction of propagation). This result is clearly connected with the local magnetic field in the vicinity of, and radially outwards from, the sunspot area itself, and indicates still one more example of the way in which radio wave phenomena may be used in the investigation of solar events.

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J. S. Hey

Department of Scientific and Industrial Research,
Park House, 24 Rutland Gate,
London, S.W.7.
Aug. 23.

[1] Appleton, *Nature*, **158**, 534 (1945).
[2] Hey, *Nature*, **157**, 47 (1946).
[3] Appleton, *J. Inst. Elect. Eng.*, **71**, 645 (1932).

Solar Radiation on 175 Mc./s.

Appleton[1] and Hey[2] have directed attention to the fact that radio-frequency energy, with some of the characteristics of random 'noise', is emitted with greatly increased intensity from the sun under the conditions of violent disturbance associated with a large sunspot. These observations were confined mainly to the region of frequencies near 60 Mc./s.

Pawsey, Payne-Scott and McCready[3], who have made observations on 200 Mc./s., suggested that radiation of this type is also observable under less disturbed conditions.

In order to investigate other aspects of this phenomenon, we have constructed a device which automatically records and measures the 'noise' received on 175 Mc./s., and which has a sensitivity such that a power of 3×10^{-15} watts (approximately 1 per cent of the receiver noise power) can be detected. This sensitivity corresponds to a thermal energy temperature of 30° K., and it has been possible to record the 'noise' received from the galaxy on a small broadside aerial consisting of eight half-wave dipoles.

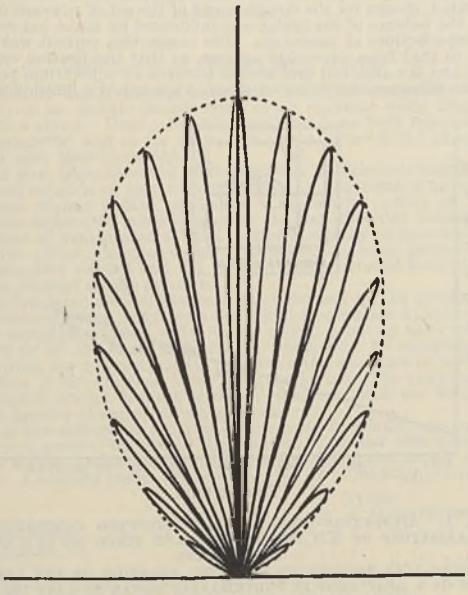

Fig. 1. Polar diagram of two 8-element aerial systems with separation of 10 λ

For the purpose of investigating solar radiation under conditions of low solar activity, it is necessary to discriminate against the background of galactic radiation. While this could be achieved by building an aerial to give a sufficiently narrow beam, a very large structure would be required, and observation would be restricted to a short time every day unless arrangements were made for moving the polar diagram of the aerial. An alternative method was therefore used, analogous to Michelson's method for determining stellar diameters. Two aerial systems were used with a horizontal separation of several wave-lengths, and their combined output was fed to the receiving equipment. Such an arrangement produces a polar diagram of the form shown in Fig. 1 where the angle between zeros is governed by the spacing of the two aerials and the envelope is determined by the polar diagram of each individual aerial system. If the angle between minima is sufficiently large compared with the solar angular diameter, then, as the aerial polar diagram is swept past the sun by the earth's rotation, any radiation from the sun should be recorded as an oscillatory trace.

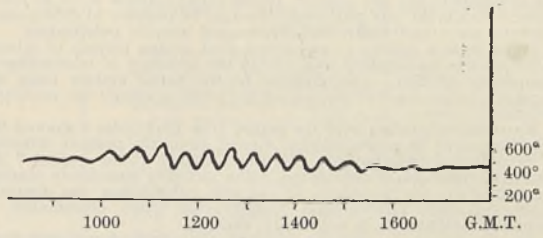

Fig. 2. Record obtained with 10 λ separation (July 17, 1946)

Fig. 2 shows a typical record obtained with an aerial separation of 10 λ, and with only slight solar activity (July 17). The oscillatory contribution due to radiation from the sun can be seen superimposed on the slowly varying background of the galactic radiation. Records of this type enable an estimate to be made of the level of solar radiation even when it is only about one quarter the galactic contribution, and at the present time we have found that the sun is usually sufficiently disturbed to give such records. The power is indicated on the diagram in terms of an 'equivalent aerial temperature', and is the power which has to be fed to an aerial in a black-body enclosure of this temperature, to maintain equilibrium. The temperature of a distant source whose radiation obeys a black-body distribution may be estimated from the observed equivalent aerial temperature by correcting for the ratio of solid angles of source and aerial polar diagram.

During the appearance of a large sunspot between July 20 and August 1, the solar radiation was much increased, and the opportunity was taken to use the apparatus to determine the angular diameter of the source, by observing the ratio of maximum to minimum intensity as the polar diagram of the two aerials with a separation of many wave-lengths was swept past the sun. This experiment was carried out with a series of different aerial spacings, the final value being 140 λ, and a sample of the records obtained with this spacing is shown in Fig. 3. The maximum/minimum ratio obtained under these conditions corresponds to a source diameter of 10 minutes of arc. Any inequalities in the two aerial systems would result in an over-estimate of diameter, and this is therefore a maximum value.

Since the value obtained does not greatly exceed the diameter of the visual spot, it is reasonable to relate the source of this radiation with the visual spot itself, or a region closely associated with it.

During the afternoon of July 25 the observed intensity attained a value which would correspond, in the case of black-body radiation from a source of this diameter, to a temperature greater than $2 \cdot 10^9$ ° K.

Since the existence of such temperatures in a region from which radiation of this wave-length would escape seems improbable, we considered that the radiation was non-thermal in origin, and the possibility of ordered electron motion was therefore investigated by an examination of the polarization of the radiation. This was carried out by arranging the two aerial systems of the 'Michelson' device to be polarized in planes at right angles to each other. If the radiation were emitted by a completely random 'thermal' source, the two perpendicularly polarized components would not be phase-coherent and no interference effects would be observed. The existence of interference effects would show the presence of phase coherence, and hence prove that the radiation was not of 'thermal' origin. Further, by noting

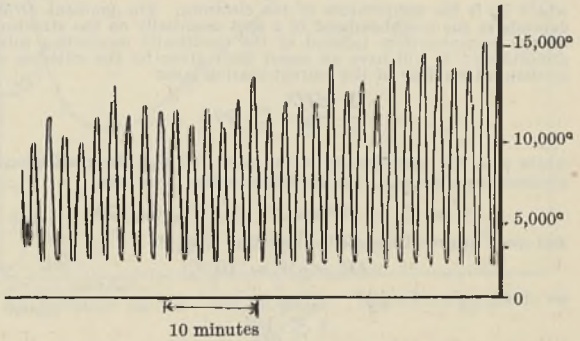

Fig. 3. Record obtained with 140 λ separation (July 26, 1946)

the direction of the sun relative to the aerial systems when an interference maximum was produced, it would be possible to differentiate between plane and right- and left-handed circular polarization.

Using such a system it was found that during periods of intense radiation the polarization was, within the accuracy of measurement, completely circular. (Inequalities in the aerial system limit the accuracy, but at least 90 per cent of the incident energy was circularly polarized.)

Measurements taken over the period July 27–August 3 showed the polarization to be anti-clockwise, viewed along the positive direction of propagation (left-handed). Between August 3 and August 7 the degree of polarization diminished, being virtually completely random on August 7. On August 8, 40 per cent polarization was observed again, but with right-handed polarity—the result, presumably, of increased activity in a subsidiary sunspot.

Any theory of the emission of circularly polarized radiation from sunspots must presumably be given in terms of the magnetic field known to be present in those spots. In considering the mechanism of such a process account must be taken of the magnetic field and electron density not only in the region appropriate to the observed frequency, but also in the overlying layers, where selective absorption of the radiation will occur, in a manner similar to the 'gyro-magnetic' phenomena familiar in the terrestrial ionosphere.

It will be necessary to collect more experimental data before possible theories can profitably be considered in detail.

M. Ryle
D. D. Vonberg

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Cambridge.
Aug. 22.

[1] Appleton, *Nature*, **156**, 534 (1945).
[2] Hey, *Nature*, **157**, 47 (1946).
[3] Pawsey, Payne-Scott and McCready, *Nature*, **157**, 158 (1946).

Origin of Solar Radiation in the 1–6 Metre Radio Wave-length Band

The intensity of the solar radiation in the wave-length region of a few metres sometimes deviates extraordinarily from that for a black body at 6000°. The observed departures show a clear correlation with sunspots and their heliographic positions, and become extremely high during the appearance of chromospheric eruptions[1]. As can be shown, even the intensity of the corona, which will radiate in this spectral region nearly like a black body at 10⁶ degrees, falls short of the observed values.

If we take account of the influence of the magnetic field of sunspots on the radiating layers, every free electron revolving in the magnetic field H becomes a transmitter, permanently emitting the frequency $\nu = eH/2\pi mc$, or the wave-length $\lambda = 2\pi mc^2/eH = 1{\cdot}07 \times 10^4/H$ cm. At the earth's distance r, such a transmitter produces an electrical field-strength E given by

$$E_\nu^2 = \left(\frac{e^2}{mc^2}\right)^2 \frac{v^2}{c^2}\frac{H^2}{r^2} = \frac{\sigma^2}{r^2}\frac{v^2}{c^2}H^2$$

where v is the thermal velocity and σ the radius of the electron. For a direction of observation parallel to the magnetic field, the radiation is circularly polarized, and for one perpendicular to the field it is plane polarized.

Let the terrestrial receiver have the band-width $\Delta\nu$; then since $\Delta\nu = (e/2\pi mc)\Delta H$ we have

$$\Delta N = \frac{\pi R^2{}_0 \bar{n}}{dH/dz} \cdot \frac{2\pi mc}{e}\Delta\nu$$

electrons contributing to the emission of the radiation received. $\bar{n}$ is here the mean density of the electrons, $\pi R^2{}_0$ the cross-section of the radiating layer ($R_0 \ll$ solar radius $r_\odot$), and dH/dz the gradient of the magnetic field in the direction of observation. If we express the received field-strength in units of the field produced by the total photosphere (assumed to radiate like a black body at 6000°), and if we take account of the fact that the resultant field strength due to ΔN electrons oscillating with arbitrary phases is proportional to $\sqrt{\Delta N}$, we get for the ratio of the squares of the field-strengths, that is, for the ratio of the intensities,

$$\frac{E_\nu^2 \text{ (electrons)}}{E_\nu^2 \text{ (photosphere)}} = i = \pi^2 \frac{T_e}{T_\odot}\left(\frac{R_0}{r_\odot}\right)^2 \frac{\bar{n}e}{dH/dz}$$

where T_e is the temperature of the electrons. The gradient dH/dz depends in the neighbourhood of a spot essentially on the structure of the current-system induced in the electrically conducting solar atmosphere; it will have an upper limit given by the criterion of mechanical stability of the current-bearing layer

$$\frac{1}{4\pi}\frac{dH^2}{dz} \leqq \rho g_\odot$$

where ρ is the mass-density of the layer and $g_\odot$ the gravitational acceleration of the sun. For the inner corona, if we take

$$\bar{n} \approx 5 \times 10^8 \text{ cm.}^{-3}, \quad T_e/T_\odot \approx 170,$$

and use a projected area of the radiating layer of

$$(R_0/r_\odot)^2 \approx 10^{-3},$$

we obtain values for i of

$$i \lesssim 10^4.$$

This seems to be of the right order. If the distribution of the magnetic field is favourable, the contribution of chromospheric eruptions

$$(\bar{n} > 10^{10}/\text{cm.}^3, \; T_e/T_\odot \gg 1)$$

and spot-type prominences

$$(\bar{n} \approx 10^{10}/\text{cm.}^3, \; T_e/T_\odot \gtrapprox 2)$$

may be still greater!

Re-absorption of the radiation by free-free or free-bound transitions under the influence of the magnetic field, as well as by resonance scattering of electrons revolving in this field, comes out as unimportant.

Taking account of the distribution of the magnetic field and the electron-density, over a spot, it can be shown that the emission is greatest normal to the spot. This agrees with the observation that the intensity is greatest if sunspots are passing the central meridian.

It can also be shown that the total intensity of the corona in the metre-band would be about 10^8 times that of the photosphere, if there were a magnetic field of about 50 gauss. The non-observation of this intensity seems to constitute an independent proof of the shielding of the general magnetic field of the sun.

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July 29.

[1] Hey, J. S., and Stratton, F. J. M., *Nature*, **157**, 47 (1946).

The Lower Curie Point of Ferro-electric Salts

Comparatively little attention has been given to the behaviour of the group of ferro-electric salts analogous to potassium dihydrogen phosphate (KH_2PO_4) at the so-called 'lower Curie point'. In this region dielectric measurements in an alternating field show a rapid decrease in the magnitude of the reversible polarization with decreasing temperature[1]. There has been indirect evidence that this can be attributed simply to the sharp rise in the coercive field, itself unexplained, which has been observed to accompany it, and that the domains of the crystal retain their high spontaneous polarization at lower temperatures. This concept of the 'freezing-in' of the electric moment has been supported by the lack of a specific heat anomaly as observed in this salt[2], and in the case of potassium di-deuterium phosphate by the constancy of the saturation polarization as inferred from electro-optical measurements[3], and by the absence of any change detectable by X-ray analysis; an angular deformation has been clearly shown by this method to accompany the onset of spontaneous polarization at the upper Curie point[4]. While in the Rochelle salt group the lower Curie point corresponds to a real disappearance of the spontaneous polarization[5], no direct experimental evidence exists in any published work for the potassium dihydrogen phosphate group of ferro-electric salts.

An investigation has been made by a static method, in which a measured charge is supplied from a compensating condenser of much larger capacity in order to maintain a fixed potential difference across a crystal of potassium dihydrogen phosphate while its temperature is altered; it has been possible by this means to show that in a constant field the electric moment of the salt is unchanged on passing through the 'lower Curie point'. At the upper Curie point the growth of spontaneous polarization can be followed, and agreement obtained with the values observed in measurements of the electric hysteresis.

Such D.C. measurements have to take account of conductivity of the order of 10^{-10}–10^{-13} ohm^{-1} cm.$^{-1}$, and Fig. 1 shows an example of one type of observation. An electrometer triode bridge is normally employed as a null indicator of correct compensation; but in the case illustrated, chosen for the completeness of the set of relevant observations, the balance of the bridge was influenced by slight but reproducible imperfections of insulation. The conduction current was almost equal to that from two other sources, so that the floating condenser plates and the attached grid tended towards an equilibrium potential, and the galvanometer deflexion slowly approached a limiting position.

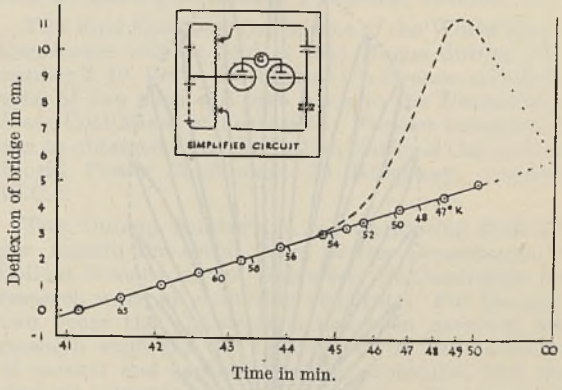

Fig. 1. Deflexion-time relation showing constancy of polarization of KH_2PO_4 in constant field at the lower Curie point
Broken line represents expected relation on the assumption of a real drop in polarization equal to that derived from the hysteresis loops

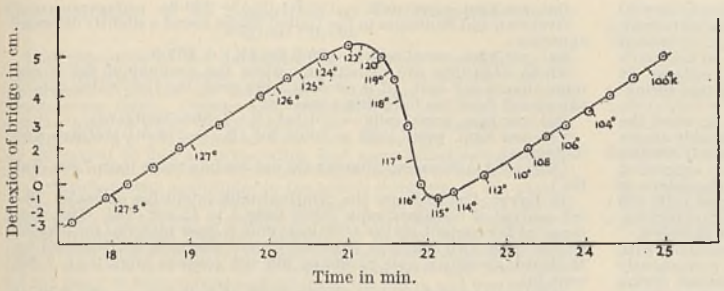

Fig. 2. DEFLEXION-TIME RELATION SHOWING EFFECT OF GROWTH OF POLARIZATION IN KH_2PO_4 AT UPPER CURIE POINT IN CONSTANT ELECTRIC FIELD

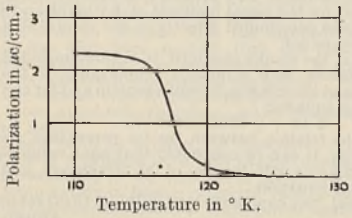

Fig. 3. DERIVED POLARIZATION – TEMPERATURE RELATION

The linearity of this drift over a small range, when plotted on an inverse exponential time-scale, is thus a justifiable criterion of the constancy of the polarization and conductivity of the crystal. The rate of drift is seen to have been unchanged on passing through the region of temperature in which the reversible polarization diminished; the broken line gives the expected deflexion of the galvanometer, if the reduction of the polarization at maximum field, shown in the hysteresis loops of the same crystal immediately afterwards, were the consequence of a real decrease of electric moment. Fig. 2 demonstrates the derivation of the polarization-temperature relation by this method at the upper Curie point. The scales of both temperature and polarization shown in the figures are still only approximate.

A fuller report will be published elsewhere, and will describe also the method for following the electric hysteresis, in which Barkhausen jumps are observed to occur some seconds and even minutes after a change of field.

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July 31.

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Oxidation of Olefins by Peracids

PERBENZOIC and peracetic acids are recognized reagents for the oxidation of an olefinic double bond to an ethylene oxide ring and thence to a glycol. Only a few abnormalities have been reported for this reaction[1,2,3], and so far as we are aware, none of the abnormal products have been identified.

It has now been observed that oxidation of di*iso*butylene by an acetic acid solution of peracetic acid gives an unsaturated alcohol, a glycol and higher boiling products. The relative yields of these substances depend to some extent on the experimental conditions: the amount of unsaturated alcohol formed is usually at least equal to that of the glycol, and may largely exceed it. In some preparations the unsaturated alcohol and the higher boiling material have formed the main product of the reaction.

The unsaturated alcohol has been characterized by the preparation of suitable crystalline derivatives and by hydrogenation to the corresponding saturated alcohol. The higher boiling products have yielded a viscous oil of the formula $C_{16}H_{32}O_3$, which may be considered as derived from the glycol $C_8H_{18}O_2$ by loss of the elements of water or by reaction of the ethylene oxide with the glycol. The examination of the higher boiling product is still in progress, with the object of isolating smaller amounts of other substances.

Work is now actively in progress to determine how far these abnormalities are a general feature of the reaction of olefins with peracids, and how far the experimental conditions determine the nature of the product. A detailed report will be submitted for publication elsewhere.

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Collapse of Capillaries in the Drying of Porous Gels

WHEN a rigid porous material, initially filled with liquid, dries out under falling vapour pressures, capillaries of particular dimensions will empty at particular vapour pressures. The remaining liquid is held under a hydrostatic tension which is transmitted to the walls but, as each capillary empties, the stresses on the walls due to this cause will fall to zero. If, however, the material is easily deformed, the tension of the liquid will cause a reduction in the size of the capillary, and evaporation will be delayed until a lower vapour pressure is reached, by which time the tension has further increased. This consideration is, so far as we are aware, a new one and is in addition to any shrinkage stresses which may result from the loss of vapour held by means other than capillary condensation. One may thus expect that, under certain conditions, capillaries may reach an unstable state where the tension in the liquid is increasing more rapidly than is the resistance of the capillary wall to further compression.

The simple case of a hollow circular tube subject to external and internal pressures[1] may serve to give a quantitative illustration. A tube made of material of bulk modulus k and rigidity n has external and internal radii r_1 and r_2 ($r_2^2/r_1^2 = A$, the proportion of void space) and is subject to an internal hydrostatic tension p; the external stress being zero. Then

$$\frac{1}{r_1}\frac{dr_1}{dp} = -\frac{1}{2(1-A)}\left(\frac{A}{k}+\frac{A}{n}\right)$$
$$\frac{1}{r_2}\frac{dr_2}{dp} = -\frac{1}{2(1-A)}\left(\frac{A}{k}+\frac{1}{n}\right). \qquad (1)$$

In the case of most hygroscopic gels, k is large compared to n, so that k terms may be neglected. If the initial, unstressed values of A and r_2 are A_0 and r_0, we have by integration, when $k = \infty$

$$A_0 + \ln\left(\frac{r_0^2}{r_2^2}(1-A_0)\right) = \frac{p}{n} \qquad (2)$$

in which p is given, in terms of surface tension (τ) and contact angle (θ), by $2\tau\cos\theta/r_2$ for capillaries large compared with molecular dimensions.

To take specific examples, consider capillaries in two water-wettable materials A and B, ($\theta = 0$). In A, $n = 6 \times 10^9$ dynes per cm.^{2} (approximately that of the cell-wall material of wood at a low moisture content); and, in B, $n = 1{\cdot}5 \times 10^7$ (approximately that of soft rubber). In each of these materials n is only a few per cent of k.

Take $A_0 = 0{\cdot}5$ in each case, then with the surface tension of water in bulk at 73 dynes/cm., equation (2) is drawn in Fig. 1, which shows the *initial* radius r_0 required to produce a given *final* radius r when the tubes are dried from saturation to a relative humidity (R.H). It shows a minimum value of r_0 at about 10^{-6} cm. and relative humidity 1 per cent for A, and at about 5×10^{-8} cm. and relative humidity 98 per cent for B. These are the smallest initial radii which can withstand drying below the corresponding minimum relative humidity without being reduced to zero cross-section by the ever-increasing tension of the water. Below the critical relative humidity no capillary water can be present and no capillary effects can be manifest since all the larger capillaries are empty and all the smaller ones have collapsed.

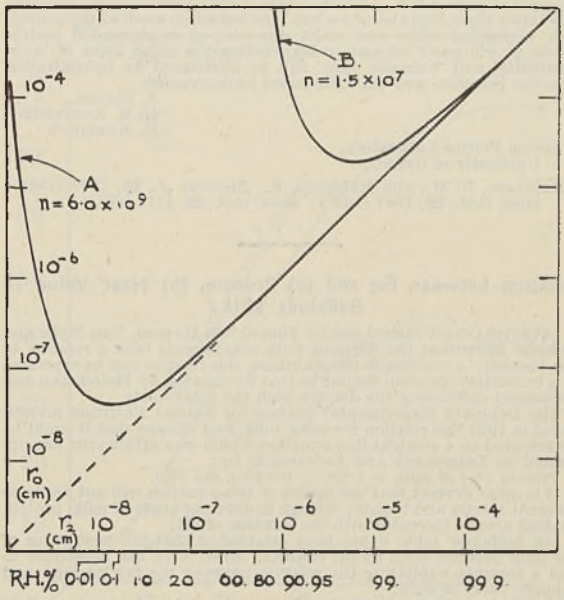

Fig. 1

These results cannot, of course, be applied quantitatively to real materials the capillary structure of which is irregular, or to such small and meaningless values of r as are obtained for curve A. Curve B has, however, a qualitative significance in showing that in materials softer than rubber, microscopically visible voids can collapse at humidities very close to saturation, causing abnormal external shrinkage at high moisture contents.

In seasoning wet wood at elevated temperatures, that is, when the rigidity is very low, anomalous shrinkage can occur in the early stages of drying. This condition is known as 'collapse', and the cell cavities are found on examination to have suffered severe distortion suggesting the flattening of evacuated rubber tubing. Previous explanations of this effect[2] have been based on the idea that water-logged cells will collapse on drying if no air is able to enter when the water evaporates. It now seems that collapse is possible even when air is not excluded.

If it be assumed that, under the very high tensions associated with the disappearance of the smaller voids, the walls remain permanently sealed together on re-wetting, one may explain how a second drying of a natural gel, such as wood, usually shows lower equilibrium moisture contents than the first, and how fine pulps (for example, paper pulp) and powders tend to adhere into larger aggregates on drying.

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Anthocyanins of *Gladiolus*

As a preliminary to genetic studies in which one of us will be concerned in collaboration with Prof. K. Hrubý, the pigments of the flower petals of *Gladiolus gandavensis* (large-flowered florist's gladioli) have been re-examined. The different varieties contain more or less of an anthoxanthin which appears to be a glycoside of apigenin or a simple derivative; this functions as a strong co-pigment. An acid aqueous extract of the yellow 'Hofmann's Glory' added to synthetic peonin or malvin makes the red solutions much bluer, and they then simulate the appropriate flower extracts. The petals do not contain a carotenoid soluble in benzene or ethyl acetate.

The system of tests has already been described[1], but it may be noted that an equivalent of the 'delphinidin reagent' is a mixture of anisole (90 c.c.), *cyclo*hexyl methyl ether (10 c.c.) and picric acid (2·4 gm.). A noteworthy feature of the results is the absence of cyanidin derivatives, although we have not been able to obtain the variety in which a cyanin type was formerly recognized. It may be noted that the streaks of colour at the base of the petals of the yellow 'Hofmann's Glory' appear to be due to anthocyanin based on cyanidin.

There are definitely three sugar types among the pelargonidin derivatives. Thus 'Crimson Glow', poppy scarlet, contains pelargonidin 3-pentoseglycoside (or rhamnoglycoside); this is probably the same pigment as that occurring in the scarlet gloxinia.

'Acca Laurentia', variegated yellow and orange, contains pelargonidin 3-bioside (two hexoses); the scarlet nasturtium is coloured by the same pigment.

'Van Tienhoven', red, and 'Rosa van Lima', delicate rose, contain pelargonidin 3 : 5-diglycoside, doubtless identical with pelargonin.

'Mrs. Marks Memary', a splendid variety with carmine flowers, is coloured by peonidin 3 : 5-diglycoside, very much blued by co-pigment.

The violet varieties examined are recent Dutch introductions and are as yet unnamed. One had deep purplish-violet flowers, like an iris or purple viola. This contained malvidin 3 : 5-diglycoside, rather strongly co-pigmented. A bluish-violet variety, less intensely coloured and much bluer, was also of malvin type but much more co-pigmented.

A variegated white and violet was also of co-pigmented malvin type. It will be of interest to see whether the sugar types of 'Acca Laurentia' and 'Crimson Glow' can be introduced by hybridization into the peonidin- and malvidin-based anthocyanins.

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[1] Robinson, G. M., and Robinson, R., *Biochem. J.*, **25**, 1867 (1931); *idem*, *ibid.*, **26**, 1647 (1932); *idem*, *ibid.*, **28**, 1712 (1934).

Relation between Fat and (*a*) Protein, (*b*) Heat Value in Buffaloes' Milk

Investigations carried out by Timpe, Nils Hanson, Van Slyke and Publow[1] show that the different milk constituents bear a relation to one another. According to these authors, this relation can be expressed in a numerical equation similar to that formulated by Fleischman and Richmond correlating the density with the total solids.

The Denmark Experimental Station for Animal Nutrition investigated in 1923 this relation for cows' milk, and showed that it could be represented in a straight-line equation which was afterwards demonstrated by Langemack and Anderson to be:

Protein (%) of milk = 1·597 + 0·446 × fat (%).

It is quite evident that the figures of this equation will not apply to different species and breeds; though in different kinds of milk, protein content always increases with the increase of fat.

For buffaloes' milk, it has been established that the heat value of the milk depends upon its fat content. Much work has been done to find a formulæ exhibiting the relation between the fat content and calorific value of milk.

Møllgard studied this relation for cows' milk[2] and expressed it in the form:

Cal. per kgm. cows' milk = 115 fat (%) + 280·6.

Overman and Sadmann in the United States found a slightly different equation:

Cal. per kgm. cows' milk = 120·6 fat (%) + 267·9.

These equations are satisfactory when the amount of fat is not more than 5 per cent; if it exceeds 5 per cent, the heat value can be calculated from the following equations:

Cal. per kgm. cows' milk = 101 fat (%) + 363 (Møllgard).

Cal. per kgm. cows' milk = 100·2 fat (%) + 376·5 (Overman and Sadmann).

(Milk used in these experiments did not contain more than 7 per cent fat.)

In Egypt, buffaloes are the principal milk-producing animals. The fat content of buffaloes' milk varies from 5 to 12 per cent. This wide range of fat content makes buffaloes' milk a good material for investigating these two relations, especially since the milk investigated by Møllgard, Overman and Sadmann did not contain more than 7 per cent fat.

Milk samples were taken from a herd of buffaloes on the farm of the Faculty of Agriculture, Fouad I University, Giza. These samples were also taken from selected individuals showing maximum and minimum fat percentage. The protein and fat content of each sample were determined by the usual methods of Kjeldahl and Gerber. The calorific value was determined directly in the calorimeter after drying the milk in filter paper.

On the basis of the results obtained, it can be concluded that protein content in buffaloes' milk is directly proportional to the quantity of fat in the milk, and the relation between protein and fat can be expressed in the following equation:

Protein (%) = 3·43 + 0·1216 × fat (%).

As regards the relation between the fat percentage and heat value of buffaloes' milk, it can be concluded that heat value per kgm. milk rises in a straight line with the rise of fat percentage, and is expressed in the following equation:

Heat value (cal.) per kgm. buffaloes' milk = 110·33 fat (%) + 278·63.

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Value of Determination of Bisulphite-binding Substances of Blood in the Diagnosis of Vitamin B_1 Deficiency

Deficiency of vitamin B_1 is associated with increase of the bisulphite-binding substances[1,2]. The increase is chiefly due to pyruvic acid and alpha-ketoglutaric acid. As the bisulphite-binding aldehyde- and keto-compounds increase in many different diseases, it is rather difficult to decide whether this augmentation can be used as an indicator of aneurin deficiency. The various authors disagree on this point[3]. Wilson[4] and others recommend the examination of the increase after administration of glucose. Chesler *et al.*[5] are of the opinion that the ratio of lactic and pyruvic acid is the decisive factor, the ratio being normally 7·7 average and 5·8–6·6 with aneurin-deficiency.

I therefore undertook determinations with eighty cases of the amounts of bisulphite-binding substances in the blood, at the same time determining the urinary excretion of aneurin after a test dose. If the increase of such substances was not due to imperfect oxidation or insufficient intake of carbohydrates (hunger with acetonuria, diet of fat without carbohydrates, diabetes), the bisulphite-binding substances of blood were mostly increased when aneurin-excretion was below normal, that is, if after intravenous injection of 10 mgm. aneurin less than 1·5 mgm. was excreted. Seventy-three cases showed this correspondence (91·2 per cent). In four cases the excretion of aneurin was decreased on account of deficient renal function, a fact not signifying hypovitaminosis in this case; the amount of bisulphite-binding sulphite was not increased. The highest amounts of bisulphite-binding substances were found when B_1-excretion was lowest, a circumstance explained by considerable deficiency of aneurin-intake or absorption in cases of cancer of the œsophagus, gastric stenosis, alcoholism, etc. After the administration of aneurin, the amount of bisulphite-binding substances decreased to normal values within hours or a few days, the B_1-excretion increasing simultaneously to normal level. These results seem to indicate that the aforesaid exceptions excluded, the content of bisulphite-binding substances increases mostly when there is aneurin-deficiency. The method is therefore suitable for determination of aneurin deficiency, if cases of diabetes, hunger with acetonuria, and unbalanced fatty diet are excluded. Hunger, of course, may cause concomitant aneurin deficiency. But it seems unnecessary to apply this circumstantial method, because the determination of aneurin excretion after a test dose (Magyar[6] and others) is simpler, as I' have ascertained by several hundred determinations conducted by its application. The method is suitable only if, on account of deficient renal, and, as I showed, of deficient liver function, the aneurin excretion is low. In these cases determination of bisulphite-binding substances decides whether the decreased excretion is due to vitamin deficiency or failure of renal- or liver-function.

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Demonstration of an Agglutinin to *Trichomonas foetus* in Vaginal Mucus

THE procedure of the demonstration of living organisms in the vaginal discharges of cattle represents the most satisfactory method at present available for the positive diagnosis of infection with *Trichomonas fœtus*. Considerable difficulties are involved, however, not the least of which arises through the capricious appearance and disappearance of the organisms from these discharges; and it was in an endeavour to find an explanation that some investigations of the properties of the discharges were made and finally led to the demonstration of trichomonas agglutinins in the mucus secretions of the vagina.

The method employed was the mixing of the mucus with melted agar, which was allowed to solidify in small Petri dishes. A suspension of live trichomonads was then pipetted on to the surface and the preparation incubated at 37° C. Agglutination was evaluated according to the scale laid down by Robertson[1] and Kerr and Robertson[2] for the assay of trichomonas agglutinins in the blood, and was actually demonstrated in the vaginal mucus of experimentally infected animals before any evidence could be found of its presence in the blood.

A series of observations that was carried out showed the disappearance of trichomonads from the discharge to coincide with the development of agglutinins in the vaginal mucus, and the subsequent reappearance of trichomonads to coincide with the disappearance of these agglutinins. It has also been noticed that the latter occurrence is usually accompanied by the appearance of a copious watery discharge which is believed to originate in the uterus[3]. The application of the test to the uterine type of discharge failed to demonstrate any agglutinins; these appeared, therefore, to be restricted to mucus from the vagina itself.

The observations seem to explain the intermittent nature of the appearance of active organisms in certain vaginal discharges; as also the well-known variability in the duration of the activity of organisms kept at room temperature in freshly collected vaginal discharges.

In addition to the demonstration of trichomonas agglutinins, it was found possible to prepare a saline extract of vaginal mucus from an animal infected with *Brucella abortus* and to show the presence of agglutinins to that organism.

This appears to be the first clear demonstration of the presence of agglutinins in vaginal mucus.

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Fluochrome in Muscle

IF crystalline myosin is made to act on adenosine triphosphate it splits off one phosphate. If the reaction is allowed to proceed to completion and the dephosphorylated product is added to actomyosin, prepared from pure actin and pure myosin, no contraction occurs. If, however, a small amount of a watery extract of muscle is added, the actomyosin contracts. The substance responsible for this reaction is an acid-stable protein. If purified and allowed to stand at alkaline reaction in air it turns yellow, displays in the ultra-violet a splendid, somewhat bluish fluorescence, and loses its activity. On addition of cysteine the colour disappears, fluorescence vanishes, and the activity returns. Evidently, the protein in question is a chromoprotein, the prostherid group of which is capable of reversible auto-oxidation, the reduced form only being active. If detached from the protein, the chromophore group becomes very labile and readily oxidizes into a non-fluorescent reddish-brown substance.

The dye is not identical with flavine or thiochrome. Its maximum of light-absorption is somewhat shifted towards the higher wavelength, as compared to flavins, and there is gradually decreasing adsorption up to 700 $\mu\mu$ with a little hump at 550.

The research was carried out at the Biochemical Institute of the University of Budapest under auspices of the Josiah Macy Jr. Foundation, New York.

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Effect of Vitamin P on the Thyroid in Guinea Pigs

MCCARRISSON[1] and other workers after him observed in scorbutic guinea pigs an increase in activity of the thyroid. In the course of experiments aimed at investigating the 'sparing' action of vitamin P on ascorbic acid, the thyroid was submitted to histological examination in vitamin P-deficient guinea pigs, as well as in guinea pigs fed on a normal diet supplemented with a mixture of *d*-catechin epimers, selected as a type of vitamin P.

A definite activation of the thyroid was observed in male guinea pigs weighing 250 gm. fed on scorbutigenic diet supplemented with 2 mgm. ascorbic acid a day. The histological picture corresponded to the *T*-stage of Heyl and Laqueur[2], while the control animals showed the *Q*—*R* stage. The result cannot be imputed to an inadequate supply of ascorbic acid, because Schulze and Linnemann[3] were able to prevent thyroid activation in guinea pigs fed on a scurvy-producing diet (presumably containing vitamin P) by a dose of ascorbic acid five times lower.

In guinea pigs, fed on a normal diet and receiving 1 mgm. *d*-catechin epimers daily, the thyroid was observed to be in the resting state on the fifteenth day: the histological picture corresponded to the *P* stage of Heyl and Laqueur[2].

It would seem that the inactivation of the thyroid is due either to a direct action of vitamin P on the gland or, more probably, to a 'sparing' effect of vitamin P on ascorbic acid.

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[1] McCarrisson, *Ind. J. Med. Res.*, 2, 693 (1920).
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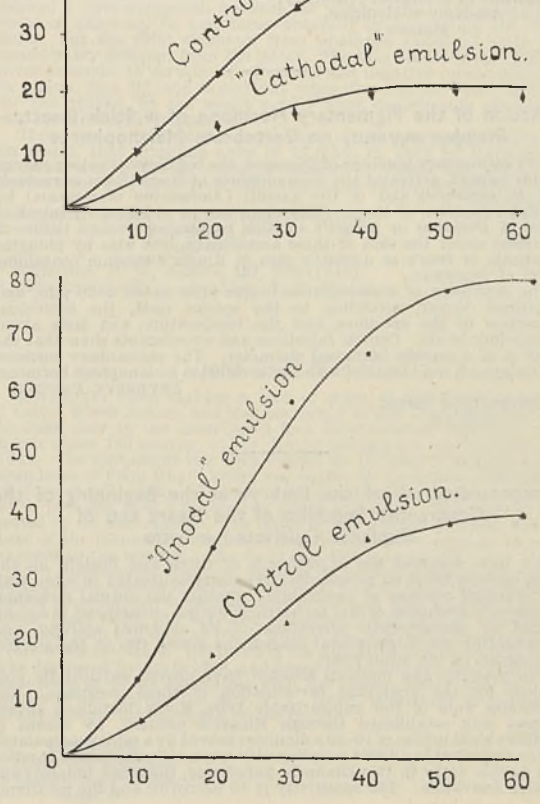
Changes in the Activity of Cholinesterase of Nervous Tissue under the Influence of Constant Current

POLARIZATION of nervous tissue with constant current leads to the accumulation of acetylcholine at the cathode and to its diminution at the anode. These facts may be explained as the result of polar changes either in the synthesis of acetylcholine, or in the intensity of its enzymic breakdown. To test the validity of the second assumption, we have investigated the influence of constant current upon the activity of cholinesterase in nervous tissue. The experiments were performed with the sciatic nerve of frogs and dogs and with the cerebral cortex of dogs.

In the experiments with cerebral cortex, one unpolarizable Du Bois Reymond electrode was applied to the cortex, the second one to the cervical muscles. Polarization was continued during 5–10 min. with a current of 8–12 mA. In the experiment with nerve trunks, one electrode (either the cathode or the anode) was applied to the nerve, the second one to the muscles; the strength of the current was 6–8 m.A.

The experiments with frog nerves were performed on isolated nerve-muscle preparations with liquid unpolarizable electrodes leading to small vessels with Ringer saline. The end of the nerve was immersed 1 cm. deep in one vessel (the volume of saline was 3 c.c.), and the muscle placed entirely in the other liquid. The polarization was performed during 5–10 minutes with a current of 0·5–1·5 m.A. in one series of experiments, and of 0·01–0·3 m.A. in another series.

After the polarization, a piece of cortical tissue was taken from under the electrode. Another piece was taken at the same time from a corresponding point of the other hemisphere as a control. In the experiments with nerve trunks, two pieces were excised after the



polarization: one from the part on which the electrode had been placed, the other one from the corresponding part of the symmetrical nerve.

The emulsions obtained from these pieces of brain or nerve tissue were centrifuged; the centrifugate was placed in a water bath at 37° for one hour to destroy the acetylcholine. After this, the activity of cholinesterase was determined either by means of the gasometric method (in a Warburg apparatus) or by means of biological assay of acetylcholine not hydrolysed after a definite period (tested on the dorsal muscle of the leech and on the m. rectus abdominis of the frog). In all experiments, the action of the emulsion prepared from the polarized (cathodic and anodic) piece of tissue was compared to that of the emulsion prepared from the control piece.

More than seventy experiments were thus performed; in 90 per cent of the experiments the activity of cholinesterase was definitely affected by polarization: acetylcholine is destroyed by emulsion of nervous tissue more slowly when the tissue has been subjected to the action of the cathode than when it has been subjected to the action of the anode. This influence of polarization upon the activity of cholinesterase was equally manifested in the cerebral cortex and in the nerve fibres.

The above data are illustrated in Figs. 1 and 2. These figures demonstrate the kinetics of the enzymic hydrolysis of acetylcholine produced by cathodic, anodic and control emulsions of frog nerve, as determined by means of the gasometric method.

CHANGES IN THE ACTIVITY OF CHOLINESTERASE IN NERVOUS TISSUE
The figures denote the volume of carbon dioxide (c.mm.) liberated in 60 min. from solutions of bicarbonate due to the breakdown of acetylcholine.

No. of exp.	'Cathodic' emulsion	Control emulsion	No. of exp.	'Anodic' emulsion	Control emulsion
1	9	34	7	61	30
2	10	32	8	68·5	30
3	12	43	9	70	41·5
4	12	44	10	73	39·5
5	13	44	11	58·5	38·5
6	12·5	43	12	62·5	39·5

The fact that the cathode of constant current lowers the activity of cholinesterase, while the anode produces the opposite effect, that is, increases the activity of this enzyme, may be explained on the basis of the changes that take place in the distribution of ions in the nerve under the influence of polarization.

It is possible that the comparative increase of univalent cations in the region of the cathode lowers the activity of cholinesterase, while the comparative increase of bivalent cations in the anodal region raises it.

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Action of the Pigmentary Hormone of a Stick Insect, *Dixippus morosus*, on Vertebrate Melanophores

THE pigmentary hormone of *Dixippus*, the regulator of colour change in this animal, activates the melanophores of frogs (*Rana temporaria* and *R. esculenta*) and of the axolotl (*Ambystoma mexicanum*) by causing expansion of them. This effect can be obtained by injecting blood of *Dixippus* or Ringer's solution containing crushed tissues of *Dixippus* under the skin of these amphibians, and also by plunging fragments of frog's or axolotl's skin in Ringer's solution containing blood of *Dixippus*.

The expansion of melanophores begins after about 5–30 min. and sometimes longer, according to the species used, the individual characters of the specimen and the temperature, and lasts about twenty-four hours. Control injections and experiments show that the effect is of a specific hormonal character. The pigmentary hormone of *Dixippus* is not identical with the vertebrate melanophore hormone.

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July 17.

Electrocardiogram of the Embryo at the Beginning of the Contractile Function of the Heart and of Explants Cultivated *in vitro*

WE have resumed the experiments of Olivo and Posteli[1] on the chick embryo heart on myocardial fragments cultivated *in vitro*, with the principal purpose of ascertaining whether the normal structural microscopic evolution of the myocardius during ontogenesis is accompanied by characteristic alterations of its electrical activity, and investigating the fundamental phenomena giving rise to the electrocardiogram of the adult heart.

The material and methods selected have proved particularly convenient for the analytical investigation of these questions. The electrodes were of the unpolarizable type, silver-chloridized silver; contact was established through Ringer's solution, by means of capillary glass tubing of 10–30 μ diameter moved by a micromanipulator.

The amplifier[2] has direct coupling with symmetrical negative reaction and double entry in two channels, permitting, therefore, unipolar and bipolar derivation. The sensitivity is 10 microvolt and the maximum amplification $1{\cdot}5 \times 10^6$: deviation is practically nil. Registration is by means of a cathode ray oscillograph, photographic objective sensitive paper and kymograph.

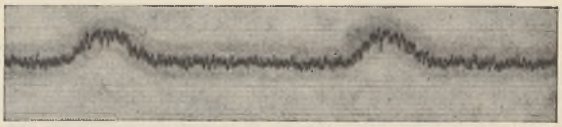

FIG. 1. ELECTROCARDIOGRAM OF A CHICK EMBRYO OF 25-H. INCUBATION, 9 SOMITES, *in vitro* FROM 40 MIN. (1 DIV. = 10^{-5} VOLT)

Young embryos. It has been shown[3] that the heart in the chick embryo begins to pulsate normally during the differentiation of the ninth pair of somites. Until the stage of 10–11 somites, the myocardius is free from myofibrillæ. Later on myocardial fibrillæ appear, first smooth then striated and in gradually increasing quantities.

The electrocardiograms of 26 embryos in the stages of 9–18 somites were recorded. In two embryos of 9 and one of 10 somites, we have obtained records consisting of a simple, slow, nearly sinusoidal half-wave. One perceives the absence of quick waves (Fig. 1). Thus we have so improved on the limit of 15 somites attained by Hoff, Kramer and others[4]. In two embryos at the stage of 7 and 8 somites respectively, the hearts of which had not begun to beat, it was possible to take a first record about an hour after the heart had begun to pulsate *in vitro*.

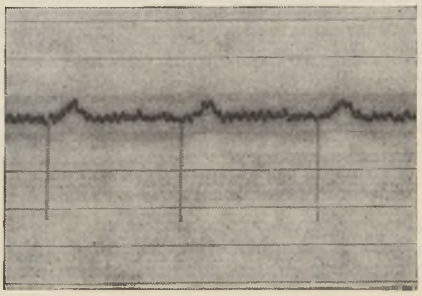

FIG. 2. ELECTROCARDIOGRAM OF AN ATRIAL FRAGMENT OF A CHICK EMBRYO OF 15-DAYS INCUBATION, *in vitro* FROM 12 DAYS (1 DIV. = 2×10^{-5} VOLT)

Quick impulses and myocardial fibrillæ. The whole embryos or the isolated cardiac primordia survive well *in vitro* and their histological differentiation progresses[5]. Taking the electrocardiogram of cardiac primordia at different stages of development, or repeatedly on the same primordium at an interval of 6–36 h., we have found that at the stage of 11–12 somites, with the appearance of the first myofibrillæ, one begins to perceive a very small quick wave which precedes the slow one. At 14–15 somites the quick wave is already stronger marked, until one obtains successively a complete electrocardiogram like that of the normal adult heart with the quick group *QRS* and the slow wave *T* (Fig. 2).

The explants cultivated *in vitro* for many days show increasing undifferentiation until the myofibrillæ totally disappear[6]. In those conditions their electrical records go back to the characters shown by the youngest primordia.

Electric potential of one fibre. We have recorded the electric potential of isolated fibres, spontaneously dissociated during cultivation *in vitro*. Such fibres are generally histologically undifferentiated. Their electric waves are slow, and quick impulses are absent.

Conduction velocity. Recording the electric potential of two points of the preparation, each in respect of the liquid in which it is immersed (unipolar derivation), and then the potential deriving from the difference of the two tensions (bipolar derivation), and as a check that obtained with the two electrodes inserted parallel, we have shown that there is a phase difference between the quick impulses at the two points. This phase difference is of the order of a hundredth of a second at distances between the two points of the order of one tenth of a millimetre.

Potentials recorded. In the very early stages (9–10 somites) the maximum potential is of the order of $50–100 \times 10^{-6}$ volt; but in all other cases, for whole embryos, myocardial fragments, and also single fibrillæ, the maximum potential recorded is of the order of $0{\cdot}5–1{\cdot}5 \times 10^{-3}$ volt.

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Source of Oxygen Liberated during Photosynthesis

PROF. HUGH NICOL'S note, "Photosynthesis, Philosophy and Priestley", in *Nature* of August 10, p. 200, mentions G. Bredig (1914) as the first to suggest that the photosynthetic oxygen comes from water. It may be of interest to know that J. Liebig (*Ann. Chem. Pharm.*, **46**, 58; 1843) gave the following picture of the carbon dioxide assimilation of plants:

$$2CO_2 + H_2 = \begin{matrix} COOH \\ | \\ COOH \end{matrix},$$

involving the formation of hydrogen and oxygen from water. More recently, I considered (*Camera-Luzern*, **4**, No. 6; 1925) a reaction in line with Willstätter's assimilatory coefficient $CO_2/O_2 = 1$ and with von Bayer's (1870) formaldehyde theory, and I formulated the following scheme:

$$H_2CO_3 + 2H + 2OH = HC\begin{matrix} O \\ // \\ \backslash \\ H \end{matrix} + H_2O_2 + H_2O_2 \text{ and}$$

$$2H_2O_2 + \text{catalase} = 2H_2O + O_2.$$

Both the reducing hydrogen and the hydroxyl radicals were supposed to be photolytic products of water. According to these formulæ three-quarters of the oxygen liberated comes from water; one molecule being involved in the reaction

$$CO_2 + H_2O = H_2CO_3$$

and two mols in

$$2H_2O + \text{activated chlorophyll} = 2H \text{ (active)} + 2OH.$$

K. Shibata and Yakushi (*Naturwiss.*, **21**, 267; 1933) give a similar representation. Four mols of water are involved to give first

$4H_2O = 4H + 4OH$, and then $4H + CO_2 = HCOOH + H_2O$.

Finally,

$$4OH = 2H_2O_2 \text{ and } 2H_2O_2 + \text{catalase} = 2H_2O + O_2.$$

According to this concept, all the liberated oxygen comes from water and none from carbon dioxide.

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A New Genus of Cucurbitaceæ

AN interesting plant was discovered in Assam in 1883 by the late Gustav Mann. Later, Mr. I. H. Burkill found it in Abor Hill during his expedition in 1911 and 1912 (Burkill, No. 37363 and 37742). After a lapse of twenty-two years, Dr. N. L. Bor again found the plant in April 1933 at a place called Painjuli, Aka Hills. Mann's sheets were examined at Kew by the late C. B. Clarke, who thought this to be a new species of *Zanonia*.

In 1939, while trying to name a few of Dr. Bor's Aka Hill collection at the Calcutta Herbarium, I came across this plant. Soon Mann's and Burkill's sheets were found and an examination was made of the floral parts. From the data obtained it was not possible to fit this new plant within *Zanonia* as suspected by Clarke. It proved to be a new genus under the tribe *Fevilleæ* of Cogniaux and is closely allied to *Thladiantha* Bunge. The description was drawn up and sent to Kew in 1940, but owing to the War the publication was delayed for a few years. The main characters of this genus are given below for the benefit of other workers in different parts of the world.

Indofevillea Chatterjee Gen. nov. Affinis *Thladiantha* Bunge sed sepalis petala longe superantibus squamis floribus nullis, antheris liberis subsessilibus, reniformibus hirsutis, pistillodio nullo fructuque multo majore satis discrepat. Species unica Assamica (*Indofevillea khasiana*).

A full account will appear in *Kew Bulletin*.

D. CHATTERJEE

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Aug. 19.

Size of Sampling Unit in Yield Surveys

IN a previous communication[1] I directed attention to the risk of obtaining biased estimates of crop yields with sampling units of small size. Further results confirming these findings are now available. Of particular interest are the results of the investigations on paddy (rice) in the Gaya district in Bihar and the Kistna district in Madras. The Gaya district has a geographical area of 4,766 sq. miles, of which approximately 35 per cent is under paddy. It is divided into four sub-divisions. The plan of sampling consisted in selecting at random 108 villages, 36 from the Gaya division and 24 from each of the other sub-divisions. In each selected village two paddy-growing fields were selected at random, and in each selected field the following five sampling units were marked: (*a*) one rectangle of size 33 ft. × 16½ ft., area 544·5 sq. ft.; (*b*) two equilateral triangles of side 15 links, area 42·4 sq. ft.; and (*c*) two isosceles right-angled triangles with the equal sides equal to 5 ft. area 12·5 sq. ft.

The sampling units (*a*) and (*b*) were marked with the help of pegs and tapes, but the sampling unit of 12·5 sq. ft. was marked with the apparatus devised and used by Mahalanobis in the Bihar rabi survey (1943-44)[2]. The experiments were carried out by the Circle officers posted in the district, each working within his own jurisdiction. Altogether seventeen officers were employed.

The results are presented in Table 1. It will be seen that the sampling unit of 12·5 sq. ft. results in a serious over-estimation of yield, the percentage over-estimation being 23. Even a sampling unit of 42·4 sq. ft. gives an over-estimate of nearly 9 per cent. An examination of the yield estimates for each sub-division showed that small-size sampling units gave biased yield estimates in all divisions.

TABLE 1. THE GAYA DISTRICT

Sampling unit	Area in sq. ft.	No. of sampling units harvested	Estimate of the average yield in lb. per acre	Percentage over-estimation
Rectangle, 33 ft. × 16½ ft.	544·5	206	991·54	
Equilateral triangle, side 15 links	42·4	412	1078·77	8·7
Right-angled isosceles triangle with equal sides 5 ft. each	12·5	412	1221·12	23·1

A proper test of bias is to compare yield estimates from sampling units of different size with those obtained from harvesting the whole field. This was not found feasible in the investigation carried out in the Gaye district. Another investigation was, therefore, carried out on paddy in the Kistna district of the Madras Province. The results are shown in Table 2. It will be seen that the yield estimate from sampling unit of 435·6 sq. ft. is in close agreement with that obtained from harvesting the whole field, but those from small-size sampling units

TABLE 2. THE KISTNA DISTRICT

Sampling unit	Area in sq. ft.	No. of sampling units harvested	Estimate of the average yield in lb. per acre	Percentage over-estimation
Whole field		108	1939·2	
Rectangular plot, 50 links × 20 links	435·60	108	1954·1	0·8
Circle of radius, 3 ft.	28·29	216	2025·9	4·5
Circle of radius, 2 ft.	12·57	216	2113·2	9·0
Equilateral triangle of side 5 ft.	11·12	216	2433·4	25·5

are over-estimates. The differences are all found to be statistically significant. An examination of the results for each sub-division also showed a close agreement between the yield estimates from sampling units of 435·6 sq. ft. and those obtained by harvesting the whole field; but the yield estimates from small-size sampling units were considerably different from the latter. The bias observed was positive (over-estimate) in certain sub-divisions and negative (under-estimate) in others, but did not cancel out when the results were combined for the district, as one might expect when experiments are carried out by several investigators.

These results confirm the conclusions of the previous investigation on wheat, that sampling units of 12·5 sq. ft. used by Mahalanobis in India[2] and of the size used by workers in Britain and the United States result in biased yield estimates under Indian conditions.

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Aug. 3.

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John Ray's Tomb

RECENTLY, when making a tour of some of the Essex churches, I visited Black Notley, and was concerned to find that the monument to John Ray in the churchyard had been seriously damaged by a bomb which fell nearby, so the Rector informs me, on December 10, 1943. The monument has been figured by Gunther ("Further Correspondence of John Ray", 1928), and earlier by Lankester ("Memorials of John Ray", 1846). It consists of a rectangular base surmounted by a pyramid with a decorative plinth and finial. The base is protected by an iron railing. The latter is only slightly affected, but the base of the monument itself was broken and blown open so as to be exposed to the weather. The finial was also snapped off.

It is unthinkable that the tomb of so famous a naturalist should be allowed to remain in such a state, and we may hope that the public bodies more directly concerned, the Royal and Ray Societies and the Essex Field Club, will take the initiative in the task of restoration. Ray was born and died at Black Notley, and spent the last twenty-six years of his life there. His home in the village, which he built in 1655, was destroyed by fire in 1900, and hence the monument is all that is left to remind us of his association with the place. I may add that the Rector of the parish, the Rev. J. L. Head, is anxious to co-operate in any scheme for the repair of the tomb.

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Aug. 15.

H. T. Shirley gave the final main contribution to the conference, "A Statistical Examination of Sources of Error in the Spectrographic Analyses of Low Alloy Steel". Most of this work was carried out with a single sample of nickel-chromium-molybdenum steel. This sample was used to prepare thirty-one plates, from each of which thirty spectrograms were read, involving some 60,000 readings from upwards of 9,000 separate lines. These readings were so taken as to permit statistical examination for the separation of the variability into three portions, corresponding essentially to: (*a*) excitation response; (*b*) plate variability over small distances comparable with the length of line read; (*c*) micro-photometry errors. For five elements considered, the mean figure for total variability, expressed as percentage of the element content, varied from 1·7 to 2·5, according to the electrode arrangement and the type of plate used. The sparking response variability made the greatest contribution to the total variability, whereas the small-scale plate variability contributed the least.

The final discussion concerned the mechanism by which research could be sponsored to improve further the analytical applications of spectroscopy. The chairman felt that such research lay largely in the province of the universities, but Dr. C. L. Wilson emphasized that if industry wanted results it should pay for them. He felt that a promising method of operation might lie in fellowships of the type now coming to the fore. In addition, however, to the foundation of such fellowships, which will supply men with the time for continued application to abstruse problems, there must be some provision made for the coincidental supply of the very expensive apparatus needed for spectrography and other physical methods of analysis.

B. S. Cooper

DETERIORATION ON STORAGE OF DRIED SKIM MILK

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C. H. LEA
Low Temperature Station for Research in Biochemistry and Biophysics, Cambridge
J. A. B. SMITH and J. C. D. WHITE
Hannah Dairy Research Institute, Kirkhill, Ayr

HENRY and Kon[1,2] found, by the method of Mitchell[3,4], that the biological value of the proteins of a bulk of dried skim milk stored at room temperature under conditions which did not exclude atmospheric moisture gradually deteriorated from 88·5 when the powder was a year and a half old to 71·1 three years later. At the end of the storage period the powder contained 7 per cent moisture. Findlay *et al.*[5] had already observed that for samples of full-cream milk powder stored at 37° C. and 47° C., there was a critical moisture content below which fat deteriorated first and above which severe non-fatty deterioration was the first to occur. The latter type of deterioration resulted in unpleasant gluey flavours, marked darkening of the powder, and a great decrease in the solubility of the protein. It was immediately realized that the two observations were probably closely related. A large-scale experiment was therefore planned by the three research institutes concerned, with the object of making a thorough investigation of the changes which occur during storage of skim milk powders.

With the helpful co-operation of the Scottish Milk Powder Company, two samples of spray-dried skim milk were prepared within a short time from very similar bulks of milk, to contain respectively 2·9 and 4·7 per cent moisture. Half of the sample containing 4·7 per cent moisture was allowed to absorb moisture from the atmosphere until the content rose to 7·3 per cent (as measured by drying for 3 hours at 100° C. under atmospheric pressure; after drying to constant weight under 30 mm. pressure at 100° C. the figures for the three powders were 3·0, 5·0 and 7·6 per cent respectively. The three powders were stored in small gas-tight cans in air or nitrogen at 37° C., 28·5° C. and 20° C. At intervals during storage the atmosphere in the cans was analysed and the powder examined for colour, solubility, moisture content and, when reconstituted, for flavour and *p*H. Changes occurring in the free amino-nitrogen of the protein and in the various nitrogenous constituents of the powder were investigated, and the amount of sugar combining with the protein was estimated. The biological value of the proteins in a number of the samples was determined by the methods of Osborne *et al.*[6] and of Mitchell[3,4], and true digestibility was measured. Microbiological assays of all essential amino-acids are also being carried out in order to determine whether the deteriorated protein is deficient in any of these acids: the results will be reported later.

Before the main experiment was started, it was thought that the deterioration of the milk proteins previously observed[1,2] might have been due to oxidative changes, and that cystine was the amino-acid most likely to be affected by them. This view was strengthened by the opinion of Fairbanks and Mitchell[7] that the initial decline, on heating, in the biological value of dried milk was due to a partial destruction of cystine. Tests showed, however, that,

CHANGES IN DRIED SKIM MILK OF 7·3 PER CENT MOISTURE CONTENT AFTER STORAGE IN NITROGEN FOR 60 DAYS AT 37° C.

		Fresh powder	Stored powder
Carbon dioxide produced (mgm./100 gm. powder)		—	5·8
Apparent moisture content of the powder, %		7·3	6·7
Equilibrium relative humidity, %		42	55
Colour of the powder, Lovibond yellow plus red units		0·5	2·2
Solubility at 20° C., %		99	70
Flavour of the reconstituted milk		Palatable	Nauseating, caramelized gluey
Casein N	Amount present in the soluble portion of the powder, expressed as % of the total nitrogen in the fresh powder	80·7	6·8
Albumin N		2·3	none
Globulin N		3·7	4·6
Proteose and Peptone N		6·8	12·8
Non-protein N		6·5	6·7
*p*H of the reconstituted milk		6·73	6·50
Reducing power[8], moles × 10^{-5} ferricyanide reduced/gm. milk solids		0·9	16·0
Free amino-N content of the protein, as % initial value		100	36
Reducing sugar combined with protein, as mgm. lactose/gm. milk solids		6	49
Biological value*, method of Osborne *et al.*[6] (gm. gain/gm. protein consumed) without added lysine		2·81†	1·82
(gm. gain/gm. protein consumed) **with added lysine		2·59†	2·55
Method of Mitchell[3,4] without added lysine		84·5	67·5
" " **with " "		76·4	80·1
True digestibility, without added lysine		91·2	86·0
" " **with " "		91·4	89·0

* Determined at an 8 per cent level of protein intake (N × 6·38) derived from 23 per cent milk in the diet.
† The values quoted here were obtained with a control sample which had been kept in nitrogen at −20° C.
** Lysine added to the milk at a rate of 2·5 per cent.

while the addition of cystine improved the biological value of the proteins of freshly dried milk from 90·4 to 95·2, it was without effect on a deteriorated powder, the change from 76·6 to 77·9 being without statistical significance. Moreover, freeze-dried milk benefited from the addition of cystine, the biological value of the proteins increasing from 90·1 to 97·3. It thus became evident that, although the biological value of the proteins of milk was from the outset limited by their cystine content, cystine was not primarily involved in the deterioration caused by the storage of dried milk.

The results of the storage experiments, of which those given in the accompanying table are typical, showed that the powder of highest moisture content, particularly at the higher storage temperatures, deteriorated rapidly, with loss of palatability, solubility and biological value of the protein. Chemical changes included a slow decrease in *p*H of the reconstituted milk, a progressive fall in the free amino-nitrogen content of the protein, and a corresponding appearance of reducing sugar in considerable quantity combined with the protein of the milk. Other changes observed were absorption of oxygen (by the samples packed in air) and evolution of carbon dioxide, crystallization of the lactose (as shown by changes in apparent moisture content and in equilibrium relative humidity of the powder), and a progressive increase in the reducing power of the powder towards ferricyanide (Chapman and McFarlane method[8]). Dialysed milk protein freeze-dried and stored at 37° C. and 55 per cent relative humidity for relatively long periods showed no appreciable loss of free amino-nitrogen, which, however, fell rapidly when reducing sugar was re-introduced prior to storage.

It seems probable that these changes arise, in part at least, as the result of a Maillard reaction between the aldehyde group of reducing sugar and free amino-groups of the protein, which will consist largely of the ε amino-groups of lysine residues, together with such terminal α amino-groups of other amino-acids as are exposed at the end of peptide chains. Certainly lysine becomes less available to rats as deterioration proceeds, and the lost biological value can be largely restored by supplementing the deteriorated powder with lysine (the addition of lysine to the control powder caused a statistically significant decrease in the biological value of its proteins; this finding, which may be compared with the observations of Murlin *et al.*[9], is now under investigation). Microbiological assay of lysine after hydrolysis with acid or with pancreatin disclosed a small or a considerable loss of this amino-acid respectively; although even after enzymic hydrolysis the loss of assayable lysine was still smaller than that indicated by Van Slyke amino-group determination on the unhydrolysed protein.

Similar changes occurred in the powder with 4·7 per cent moisture, but at a much slower rate. In the powder with 2·9 per cent moisture deterioration was relatively very slight even after a year at 37° C. The temperature coefficient for deterioration was unusually high, with the result that at high storage temperatures the rate of deterioration of powder of high moisture content was very rapid indeed. An atmosphere of nitrogen instead of air slightly retarded protein deterioration, but failed to prevent it.

Protein deterioration on storage has previously been observed by chemical or biological methods in wheat and wheat flour[10], in soya-beans[11,12], in maize[11,13] and in egg white[14]. Destruction of lysine by heat has been observed in milk[15], casein[16] and oat protein[17]. With casein and oat protein, some of the lysine was rendered unavailable to enzymic digestion, although it could still be released by acid[17,18].

The experiments are still in progress, and will be described in detail later. It is important, however, that the very deleterious effect of high moisture content on the nutritive value of dried milk should be known, so that this type of deterioration may be avoided in future by manufacturing only powder of low moisture content and by storing the powder in moisture-proof containers, conditions which can readily be fulfilled.

We are indebted to Dr. R. A. Kekwick, Lister Institute of Preventive Medicine, for the preparation of the freeze-dried milk.

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VITAMIN B AND FAT ANABOLISM

THE ability of the higher animals to synthesize fat from both carbohydrate and protein sources, first shown by Lawes and Gilbert in 1852 in connexion with the fattening of pigs, has been fully confirmed by modern researches on rats. It is now clear that the various B vitamins are intimately concerned in these processes of fat synthesis. Recent developments in this field are largely due to E. W. McHenry of Toronto, and have been reviewed by E. W. McHenry and M. L. Cornett (*Studies from the Connaught Laboratories and School of Hygiene, University of Toronto*, **16**; Univ. of Toronto Press, 1945).

Concerning the synthesis of fat from carbohydrate, it was shown that the amount of body fat laid down by rats on a high-carbohydrate fat-free diet was dependent on the B vitamins present in the diet. In the absence of thiamin no fat at all was laid down; when thiamin was added, considerable fat deposition occurred and the respiratory quotient rose well above unity. With thiamin present, the amount of fat laid down could be further increased by the addition of riboflavin, pyridoxin, pantothenic acid or biotin to the diet, but in the absence of thiamin the other B components had no effect. It seems that thiamin is essential for the synthesis of fat from carbohydrate and that other components of the B complex can augment the synthesis.

The fat laid down under the influence of thiamin differed considerably from the 'normal' body fat of the animal; it contained a higher proportion of C_{16} acids and a lower proportion of unsaturated acids. When other B components were fed in addition to thiamin, the quality of the deposited fat was further changed. The relative proportion of C_{16}, C_{18} and unsaturated acids depended on the relative proportion of the various B components in the diet. In particular, biotin increased the formation of unsaturated acids. So not only do the vitamin B components increase the quantity of synthesized fat but also, severally, they determine the quality of the fat.

In these experiments deposition of cholesterol always paralleled the deposition of neutral fat. It is generally recognized, however, that changes in cholesterol always accompany changes in neutral fat, however produced, and there was no reason to suppose that the B vitamins had any specific effect on cholesterol synthesis.

The question arises, can this function of thiamin in fat synthesis be linked in any way with its more generally known function in carbohydrate metabolism? It is known that thiamin is necessary for the enzymic removal of the pyruvic acid which results from carbohydrate catabolism, for pyruvate accumulates in the blood of thiamin-deficient animals. The chemical pathway from carbohydrate to fat is still not certainly known, but considerable evidence points to acetaldehyde as the intermediate compound. It is possible, therefore, that one way in which thiamin removes pyruvate is by converting it to acetaldehyde, the acetaldehyde being then synthesized to fat. Another observation which can be correlated here is the 'thiamin-sparing' action of fat. On a high-fat diet, less thiamin is required for normal maintenance. The explanation of this may be that under these conditions there is no call for fat synthesis, so no thiamin is consumed in this process and more is available for other functions.

Concerning the synthesis of fat from protein, it was shown that in rats on a diet high in protein and free from carbohydrate, fat and vitamin B, body fat was only laid down when thiamin and pyridoxin were added to the diet. It was also shown that thiamin and pyridoxin were essential for the formation of glycogen from protein, but other evidence suggested that the synthesis of fat from protein does not proceed via carbohydrate. It is also known that pyridoxin-deficiency develops more rapidly on a high-protein diet, and it seems likely that pyridoxin is concerned in some way with protein degradation.

This new knowledge of the importance of B vitamins in fat synthesis raises a point in connexion with the so-called 'essential' fatty acids. It is well known that when certain unsaturated fatty acids (linoleic and linolenic) are absent from the diet, rats show loss of weight and also skin lesions, and it was concluded from these experiments that these fatty acids were essential to the animal economy and that the animal body had no power to synthesize them. In these experiments, yeast was used to provide the B vitamins, and re-examination of the experimental data shows that the supply of some of the B components, notably biotin and pyridoxin, may have been suboptimal. The possibility that, given an optimal supply of all the B vitamins, the animal can in fact synthesize these unsaturated fatty acids, requires further investigation.

PURIFICATION AND ADSORPTION OF DIPHTHERIA TOXOID

By HANS ERICSSON

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THE method for purification of diphtheria toxoid, which has been used at the State Bacteriological Laboratory of Sweden since 1943, consists of two different procedures: the so-called iso-electric precipitation with trichloracetic acid of the crude toxoid and the aluminium precipitation of the partially purified material. The method, described briefly in an earlier publication[1], is founded on investigations by Boivin and Yzard[2] and by Glenny and Barr[3].

Boivin and Yzard described a method for purification of different toxins and toxoids, including diphtheria toxoid, by precipitation of the toxoid with trichloracetic acid and resolution of the precipitate in sodium phosphate solution. In a second publication[4], Ramon, Boivin and Richou found that the solution of the purified toxoid had the same biological activity as the crude toxoid.

Glenny and Barr[3] found that the immunizing power of diphtheria toxoid was enhanced by addition of alum, and that it was possible to purify the toxoid by separating the precipitate formed and redissolving it in Rochelle salt solution. They did not discuss further the nature of the process and the composition of the precipitate.

By an appropriate combination of the methods of Boivin and Yzard and of Glenny and Barr, I found it possible to obtain a rather high degree of purification and a firm adsorption of the active substance to the precipitate. For practical purposes the purification and adsorption procedure has been used for toxoid prepared on broth according to Philippe and Loiseau only; but it should be applicable on other toxoids as well, and the method may give still better results if, for example, semi-synthetic mediums are used for the toxin production.

The initial material consists of Ramon's toxoid prepared from the cultures in broth according to Philippe and Loiseau. It contains up to 40 Lf. and about 5 mgm. of total nitrogen per c.c., corresponding to 8 Lf. per mgm. of nitrogen. The *p*H of the crude toxoid is lowered to 3·0–3·5 by addition of an appropriate amount of a 50 per cent solution of trichloracetic acid, which precipitates the active substance. The precipitates are collected by centrifugation, redissolved in a 3 per cent solution of sodium dihydrogen phosphate, giving a *p*H of 8·4, and finally tested for toxoid content by the flocculation method of Ramon. Care should be taken that the iso-electric precipitation is carried out at a temperature of 18° C. The yield is about 90 per cent of the original amount of toxoid.

The second stage of the process consists in the precipitation by aluminium salt. Aluminium chloride is added as a sterile solution containing 96 gm. per litre, 1 litre being added to 9 litres of purified toxoid. By this addition the *p*H of the solution is lowered to about 4·5 and a precipitate of aluminium phosphate is formed. The precipitate is left to settle over-night. On the following day the supernatant fluid is syphoned off as completely as possible, and a physiological solution of sodium chloride substituted for it. The *p*H is adjusted to 5·8. Before the flocculation, the

precipitate is dissolved by addition of a few grains of sodium citrate.

The iso-electric precipitation forms the main part of the purification procedure, giving a purification of about twenty times. The aluminium precipitation is mainly intended to give a precipitate of aluminium phosphate, enhancing the immunizing power of the toxoid.

The end product contains about 50 Lf. per c.c., 0·2 mgm. of nitrogen and 1·0 mgm. aluminium per c.c. The concentrations of the different solutions are chosen so as to give finally a buffered physiological solution of sodium chloride of *p*H 5·8.

The immunizing power of the toxoid has been tested by inoculation of guinea pigs at the Swedish laboratory and also by Glenny at the Wellcome Research Laboratories and has been found to fulfil the British requirements for diphtheria toxoid.

A toxoid manufactured in this way has been used for public immunizations of children in Sweden, about two million injections having been carried out during 1944–45. The primary results as judged by the conversion-rate of the Schick reaction are excellent, one single injection of 50 Lf. changing the reaction from positive to negative in 98 per cent of the cases. The duration of the negative Schick reaction has not yet been sufficiently controlled, but would not be expected to be very long after a single injection. Epidemiological evidence tends to show that the general immunizations against diphtheria in Sweden during the War have been effective.

[1] Ericsson, H., *Nord. Med.*, **20**, 1759 (1943).
[2] Boivin, A., and Yzard, Y., *Compt. Rend. Soc. Biol.*, **124**, 25 (1937).
[3] Glenny, A. T., and Barr, Mollie, *J. Path. and Bact.*, **34**, 131 (1931).
[4] Ramon, G., Boivin, A., and Richou, R., *Compt. Rend. Soc. Biol.*, **124**, 28 (1937).

CARNEGIE CORPORATION OF NEW YORK

ANNUAL REPORT

THE annual report of the Carnegie Corporation of New York for 1945 includes the reports of the president, the secretary and the treasurer for the year ended September 30, 1945. Grants voted amounted to 1,002,500 dollars for undertakings connected with the war effort and for projects of long-term interest to the Corporation. The total of 567,000 dollars during the year for undertakings connected with the national emergency raises the total of such grants during the past five years to 2,711,867 dollars. Grants to established national research agencies for studies of education and economics include 75,000 dollars to the Carnegie Foundation for the Advancement of Teaching, for the development of its graduate record examination project; 75,000 dollars to the American Council on Education for a study of the implications for civilian education of educational experience in the armed forces; 25,000 dollars to the National Bureau of Economic Research and 5,000 dollars to the National Academy of Sciences for preliminary work in connexion with the establishment of a research board for national security. Agencies concerned with research and general education in foreign affairs received grants amounting to 257,000 dollars, including 100,000 dollars to the Carnegie Endowment for International Peace, 50,000 dollars to the Institute of International Education, 42,000 dollars to the Institute of Pacific Relations and 45,000 dollars to the Council on Foreign Relations.

In his inaugural report, the new president, Mr. D. C. Josephs, reviews the purposes of the Corporation, the general standards to be maintained in making grants and the dangers likely to arise in giving money to institutions and individuals. The Carnegie Corporation is an American foundation, most of the resources of which have been dedicated to the service of the American people, and accordingly the Corporation should not hesitate to provide funds for those who can show better ways to democracy, to the freedoms of thought, race, religion and enterprise. Projects selected for support must, however, be not only of public interest, but also, because the Corporation's income is limited, they must have great possibility of public benefit. Pointing out that knowledge is advanced by new ideas which may not yet be sufficiently developed to fit into a formal list, Mr. Josephs declines to list the kinds of projects or define precisely the fields which the Corporation should cultivate, but indicates some of the requirements which should be met before an enterprise may be supported. In particular, he points out that its support should be reserved for enterprises that deal with causes rather than effects. Once the project has proved itself or become useful, it should be supported by less venturesome money and the Corporation will withdraw support. Money is given to a man or an institution who has an idea and has the force and skill to advance it towards a conclusion.

Discussing next the dangers in giving, Mr. Josephs notes that premature endorsement may destroy good ideas that have not yet been sufficiently developed. If a large amount of money is ploughed into any field, a crop of results of some sort is fairly sure to follow; but it is possible to raise a crop which has a bad effect on neighbouring fields, and by overstimulating the development of certain subjects research may be made to run far ahead of ability to integrate. Integration may also be attempted before enough research has been done. Another danger is that of offering generous grants too widely to individuals in academic life. A year or two of stimulating investigation with the assistance of a grant may tempt an effective teacher to desert the field in which he has been successful, or he may become loath to return to the classroom. Mediocrity and dispersion are two particular dangers in handling philanthropic funds because they are insidious.

Mr. Josephs notes that it has been a long-established policy in the Corporation not to contribute to social service organisations established to relieve need or misfortune. In view of the endowments of the Carnegie Institution of Washington, it is not probable that many grants of the Carnegie Corporation will be made to develop biological and physical sciences, nor is it expected that much, if any, of the income of the Corporation will go in future to permanent endowments or for bricks and mortar. It is the purpose of the Carnegie Corporation to share in creative enterprises, and Mr. Josephs hopes that the Corporation will be able to consider proposals from those who were prepared to devote their energies to proving or disproving the reality of their vision in the field of formal or informal education, whether in the traditional or in a wider sense.

FORTHCOMING EVENTS

Tuesday, September 10—Wednesday, September 11

INSTITUTE OF METALS (at the Institution of Civil Engineers, Great George Street, London, S.W.1).—Autumn Meeting.

Tuesday, September 10

At 2.30 p.m.

Wednesday, September 11

At 10 a.m.

Wednesday, September 11

ROYAL INSTITUTE OF CHEMISTRY (in the Small Assembly Hall, Town Hall, Luton), at 6.30 p.m.—Dr. A. M. Ward: "Science as a Career".

BRITISH ASSOCIATION OF CHEMISTS (at Gas Industry House, 1 Grosvenor Place, London, S.W.1), at 7 p.m.—Mr. J. S. Evans: "The Factory Acts as they Affect Chemists".

Friday, September 13

PHYSICAL SOCIETY, OPTICAL GROUP (in the Physics Department, Imperial College of Science, Imperial Institute Road, London, S.W.7), at 3 p.m.—Scientific Papers.

Friday, September 13—Sunday, September 15

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at the Fyvie Hall, The Polytechnic, 309 Regent Street, London, W.1).—Twenty-first ASLIB Conference.

Friday, September 13

At 4 p.m.—Tea and Conversazione; at 6 p.m.—Annual General Meeting.

Saturday, September 14

At 10.30 a.m.—Sir Reginald Stradling, F.R.S.: "Special Libraries in Research Organisations" (Presidential Address).

Sunday, September 15

At 10.30 a.m.—Symposium on "Some Aspects of Documentation in Europe To-day" (Speakers: Mr. Lancaster-Jones, Miss Esther Simpson and Mr. Ronald Fraser).

APPOINTMENTS VACANT

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

RESEARCH ASSISTANTS, WORKSHOP TECHNICIANS and DRAUGHTSMEN, in the Department of Physics—The Registrar, The University, Liverpool (September 14).

LECTURER IN CHEMISTRY, and a LECTURER IN PHYSICS AND MATHEMATICS—The Clerk, Northern Polytechnic, Holloway, London, N.7 (September 14).

LECTURER (Grade II) for Fisheries work at the Port Erin Station, and a RESEARCH ASSISTANT (with knowledge of some branch of Biology and of Mathematics)—The Registrar, The University, Liverpool (September 15).

LECTURER IN THE DEPARTMENT OF ANATOMY—The Registrar, University College of South Wales, Cathays Park, Cardiff (September 16).

ASSISTANT LECTURER IN ZOOLOGY—The Secretary, King's College, Strand, London, W.C.2 (September 16).

LECTURER IN GEOGRAPHY—The Secretary and Registrar, The University, Bristol (September 20).

LECTURER with special responsibility in PRODUCTION ENGINEERING in the Coventry Technical College—The Director of Education, Education Offices, Coventry (September 21).

ASSISTANT PHYSICIST for duties in the X-Ray and Radium Department of the North of England Joint Cancer Organisation—The Town Clerk, Town Hall, Newcastle-upon-Tyne (September 21).

RESEARCH ASSISTANT IN PLANT PHYSIOLOGY, and an ORGANIC CHEMIST, at the Long Ashton Research Station—The Secretary and Registrar, The University, Bristol (September 21).

JUNIOR BIOCHEMIST at the Teaching and Research Laboratory in the Maudsley Hospital Post-Graduate Medical School, Denmark Hill, Camberwell, London, S.E.5—The Medical Officer of Health (B), Mental Health Services, County Hall, Westminster Bridge, London, S.E.1 (September 22).

LECTURER IN PHYSICS—The Principal, Derby Technical College, Normanton Road, Derby (September 23).

LECTURER IN EXPERIMENTAL PHYSIOLOGY—The Registrar, The University, Manchester 13 (September 27).

RESEARCH CHEMIST, and a RESEARCH PHYSICIST, in the Department of Glass Technology—The Registrar, The University, Sheffield (September 28).

LECTURER AND FIELD WORK SUPERVISOR, and a SENIOR DEMONSTRATOR (Group Work Supervisor), in the Department of Social Studies, The University, Melbourne—The Secretary, Universities Bureau of the British Empire, 24 Gordon Square, London, W.C.1 (September 30).

MUSEUM ASSISTANT (man or woman) in the DEPARTMENT OF ZOOLOGY—The Secretary, University College, Gower Street, London, W.C.1 (September 30).

CHAIR OF MINING—The Secretary, The University, Edmund Street, Birmingham 3 (October 1).

PRINCIPAL RESEARCH OFFICER or SENIOR RESEARCH OFFICER, Division of Industrial Chemistry, Melbourne, to engage in the development of a Section of Ceramics Research—The Secretary, Australian Scientific Research Liaison Office, Australia House, Strand, London, W.C.2, quoting No. 957 (October 4).

SENIOR ASSISTANT IN MATHEMATICS, a SENIOR ASSISTANT IN PHYSICS, and a SENIOR ASSISTANT IN CHEMISTRY—The Director of Education, The Polytechnic, 309 Regent Street, London, W.1 (October 11).

LECTURER IN MICROBIOLOGY in the Department of Bacteriology—The Registrar, The University, Sheffield (October 21).

DIRECTOR OF THE WEST AFRICAN INSTITUTE OF TSETSE FLY AND TRYPANOSOMIASIS RESEARCH—The Director of Recruitment, Colonial Office, Victoria Chambers, 15 Victoria Street, London, S.W.1 (October 30).

CHAIR OF ELECTRICAL ENGINEERING—The Secretary, The University, Edmund Street, Birmingham 3 (November 1).

LECTURER IN THE DEPARTMENT OF PATHOLOGY in the Medical School, Dundee—The Secretary, The University, St. Andrews (November 16).

ECONOMIC BOTANIST for service in the Research Division, Department of Agriculture and Forests, Sudan—The Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, endorsed 'Economic Botanist, 168'.

LECTURER IN THE DEPARTMENT OF METALLURGY AND CHEMISTRY, College of Technology—The Director of Education, Education Offices, Rotherham.

LECTURER IN DAIRY TECHNOLOGY at the Massey Agricultural College, Palmerston North—The High Commissioner for New Zealand, 415 Strand, London, W.C.2.

ASSISTANT PHYSICIST to the Birmingham National Radium Centre—The Secretary, Queen Elizabeth Hospital, Birmingham 15.

SENIOR STRUCTURAL ENGINEER, and ENGINEERING RESEARCH ASSISTANTS (with honours degree in civil or mechanical engineering)—The Director of Research, British Welding Research Association, 29 Park Crescent, London, W.1.

TECHNICIAN (Grade B) IN THE PHYSIOLOGY LABORATORY—The Dean, Medical College, St. Bartholomew's Hospital, West Smithfield, London, E.C.1.

LABORATORY ASSISTANT (Grade II) IN THE BIOLOGY DEPARTMENT—The Secretary, King's College of Household and Social Science, Campden Hill Road, London, W.8.

LECTURER IN THE ELECTRICAL ENGINEERING DEPARTMENT—The Registrar, Technical College, Sunderland.

LECTURERS (2) IN MINING, a SENIOR LECTURER IN MECHANICAL ENGINEERING, LECTURERS (2) IN ENGINEERING, a LECTURER IN PHYSICS, and a LECTURER IN MATHEMATICS—The Principal, Wigan and District Mining and Technical College, Wigan.

LECTURER IN METALLURGY at the Constantine Technical College—The Director of Education, Education Offices, Middlesbrough.

LECTURER IN PHYSICS, a LECTURER IN MATHEMATICS, and a LECTURER IN CHEMISTRY—The Principal, Sir John Cass Technical Institute, Jewry Street, London, E.C.3.

LECTURERS IN THE CIVIL AND MECHANICAL ENGINEERING DEPARTMENT—The Secretary, Northampton Polytechnic, St. John Street, London, E.C.1.

LECTURER IN BOTANY—The Principal, Heriot-Watt College, Edinburgh.

LECTURER IN MECHANICAL ENGINEERING—The Principal, Heanor Mining and Technical School, Ilkeston Road, Heanor, Nottingham.

LECTURER IN METALLURGY—The Clerk to the Governing Body, Battersea Polytechnic, Battersea, London, S.W.11.

LECTURER IN MATHEMATICS—The Acting Principal, Technical College, Huddersfield.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Other Countries

B.A.N.Z. Antarctic Research Expedition, 1929–1931. Reports, Series A. Vol. 4 (Meteorology and Terrestrial Magnetism), Part 1: Terrestrial Magnetism. By Dr. Clinton Coleridge Farr. Pp. 32. 3*s.* 6*d.* Reports, Series B (Zoology and Botany). Vol. 4, Part 7: Endoprocta. By Dr. T. Harvey Johnston and L. Madeline Angel. Pp. 213–232. 3*s.* 6*d.* Vol. 4, Part 8: Nemerteans of Kerguelen and the Southern Ocean. By Dr. J. F. G. Wheeler. Pp. 233–256. 3*s.* 6*d.* Vol. 4, Part 9: Decapod Crustacea. By Herbert M. Hale. Pp. 257–286. 5*s.* Vol. 5, Part 1: Pycnogonida. By Dr. Isabella Gordon. Pp. 72. 10*s.* Vol. 5, Part 2: Parasitic Nematodes. By Dr. T. Harvey Johnston and Patricia M. Mawson. Pp. 73–160. 12*s.* 6*d.* (Adelaide: Barr Smith Library, The University, 1940–1945.) [53

South Australian Museum. Report of the Museum Board, February 1st–June 30th, 1940, and July 1st, 1940–June 30th, 1941. Pp. 11. Report of the Museum Board, July 1st, 1944, to June 30th, 1945. Pp. 9. (Adelaide: South Australian Museum, 1942–1945.) [53

Catalogues

'Cintel' Photoelectric Cells and Multipliers. (Handbook No. P.C.1.) Pp. 24. (London: Cinema-Television, Ltd., 1946.)

A Catalogue of Miscellaneous Books, Old and Modern, in various Departments of Literature. (Catalogue No. 500.) Pp. 30. (Cambridge: Bowes and Bowes, Ltd., 1946.)

General Literature; Naval History, Ships and Shipping; Military History, Regimental Records, etc.; together with a Selection of Recent Purchases. (Catalogue No. 678.) Pp. 100. (London: Francis Edwards, Ltd., 1946.)

Catalogue of Medical, Surgical, Nursing, Dental and Scientific Books. Pp. 64. (Edinburgh: E. and S. Livingstone, Ltd., 1946.)

Insecticides and Fungicides. Pp. 24. (Wheathampstead: The Murphy Chemical Co. Ltd., 1946.)

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