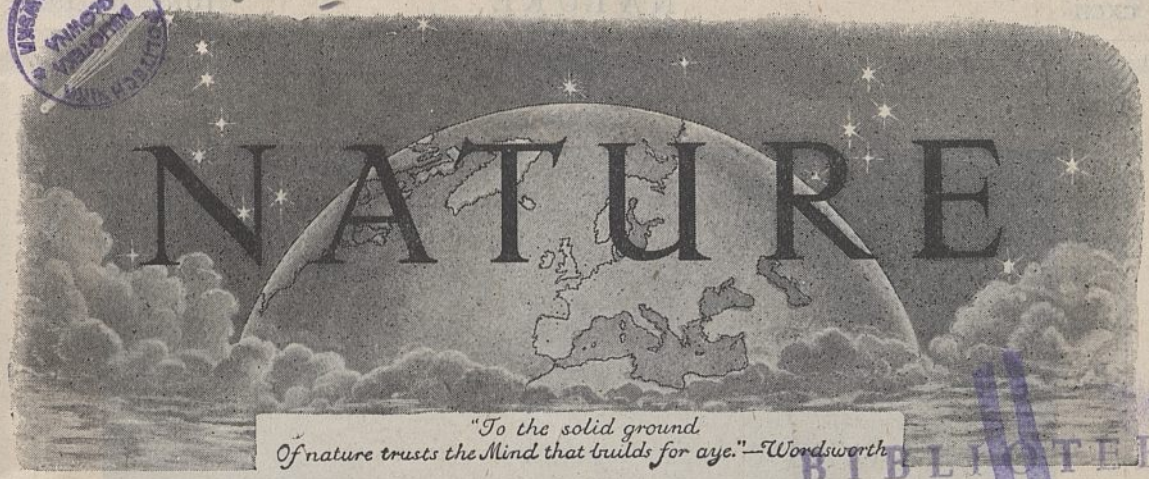

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His view that the question of League reform requires long and expert consideration and should not be undertaken until the passions aroused by the War have had time to cool is not likely to be seriously challenged. Furthermore, the Government is clearly committed in the speeches to which we have already referred to making full use of the institutions or organizations already available, and the first report of the Combined Raw Materials Board also looks forward to constructive work after the War.

The most significant move in this field is undoubtedly Mr. Eden's recent visit to the United States. Mr. Wallace's blunt assertion that unless the Western democracies and the U.S.S.R. come to a satisfactory understanding before the War ends another world war is inevitable, is a reminder that the principal condition of a lasting peace is an adequate political system within the framework of which co-ordinated economic and social policies can thrive. The essential task of organizing military and economic power for the fulfilment of common purposes and for the benefit of all cannot be entirely postponed until the final peace settlement and the determination of some permanent organization of world order. It is a condition of the re-establishment of order itself, of facilitating passage from war and chaos to order, and it is imperative that due thought should now be given to the conditions, the ways and means upon which the essential Anglo-American and Russian co-operation can be achieved.

The future peace will most assuredly depend largely upon what is done and what is left undone during the War. The essential means of political and economic co-operation will be developed most naturally out of the organizations, already in action or being established, to control and direct the common effort in war and in the immediate work of relief and rehabilitation in the occupied countries as they are liberated. Planning cannot well go beyond this point, but the experience of the organizations already in being, like those discussions in which Mr. Eden has been concerned on the needs of peace as well as those of the War, have a further contribution to offer in fostering the mutual confidence and tolerance which are as essential in peace as in war.

Independently of Mr. Eden's visit, American opinion was increasingly recognizing the necessity of effective and continuous international co-operation, military, political and economic, not only to win the War but also to safeguard the peace after the War. The American Senate has already given clear evidence of a realistic approach to the post-war world and of constructive rather than isolationist thinking about international relations.

That process must continue and be fostered by exchange of visits and by the mutual study of the common problems in a spirit of good will and understanding of the difficulties peculiar to each great democracy. What is somewhat disconcerting is to find that in the specific instance of the International Labour Organisation, in spite of the tributes paid to it by Sir William Jowitt and Mr. Eden last December, scarcely anything has been done to strengthen it and develop it into the main instrument giving effect to Article 5 of the Atlantic Charter. Plans for enlisting the services of the International Labour Organisation scarcely exist, and in spite of these public tributes there has been a lamentable failure on the part of the Allied Governments chiefly concerned—Great Britain and the United States—to strengthen the Organisation and fit it to perform the tasks which are to be entrusted to it.

The contrast between the tributes paid on all sides to the work of the International Labour Organisation and this comparative neglect or inactivity is emphasized when we recall that, at the great conference in New York in October 1941, it was declared that the International Labour Organisation is peculiarly fitted to help in such tasks as the feeding of peoples in need, the reconstruction of devastated countries, the restoration of industry, the resettlement of populations and the raising of standards of living. The Organisation received a social mandate, and in April 1942 the emergency committee of the governing body met to carry a stage further the work begun in New York. Twelve months later, however, it appears that the international committee which, by the decision of the London meeting, was to be charged with the study of how to apply Article 5, has still to be constituted.

There would be less anxiety at this slow pace if there were substantial evidence that the Allied Governments were active in their planning on other lines. There is something to be said for an approach by committees within the United Nations rather than within the framework of an organization which includes non-belligerents and neutrals. The existence of certain technical difficulties, however, has to be set against the overwhelming advantage of the International Labour Organisation in the association of organized employers and workers on equal terms with Governments. Mr. Eden's statement on his visit to the United States did little to meet this basic charge, but he at least quoted with approval Mr. Sumner Welles: "We cannot afford to permit basic issues by which the destiny of mankind will be determined to be resolved, without prior agreement, by a group of harassed statesmen working against time".

More positive encouragement may perhaps be drawn from the White Paper "Proposals for an International Clearing Union" which was issued by the Government for discussion by the United Nations. The main proposals refer to the establishment of a Currency Union based on international bank-money, called bancor, fixed (but not unalterably) in terms of gold and accepted as the equivalent of gold by the members of the Union for the purpose of settling international balances. The proposals are formed to cover one of the main lines of approach to the post-war transition from relief and urgent reconstruction into the normal world, but the White Paper recognizes that the Clearing Union might become the instrument and support of international policies besides those with which it is primarily concerned. It might become the pivot of the future economic government of the world. It might, for example, set

up a clearing account in favour of international bodies charged with post-war relief, rehabilitation and reconstruction, and supplement this by granting preliminary overdraft facilities in favour of these bodies. The Union similarly might set up an account in favour of any supernational policing body which may be charged with the duty of preserving the peace and maintaining international order. It might set up an account in favour of international bodies charged with the management of a commodity control, and finance stocks of commodities held by such bodies. It is all to the good that almost simultaneously there should be announced in the United States a second plan for debate, namely, a World Stabilisation Fund.

The White Paper, in fact, brings us back to the critical examination of the very foundations of British foreign policy to which attention was directed in a recent broadsheet of Political and Economic Planning. The basic pre-suppositions of our foreign relations in the nineteenth century which permitted a remarkable stability and continuity of policy can no longer be accepted as valid. The very fundamentals of our policy have to be re-thought and new presuppositions hammered out which will permit a similar continuity of policy in the coming years. This means, as the broadsheet reminds us, thinking in terms, not merely of this year and next, but of decades and even half-centuries, as well as of the whole range of relations—political, economic, social and cultural.

The main elements which have affected foreign policy in this way are, first, the high degree of integration and interdependence in human affairs which technical advance has brought about, with the consequence that many of the shibboleths of nineteenth century ideology have become meaningless. Secondly, the functions of the State are no longer restricted to the maintenance of internal order, external security and the conduct of diplomatic relations. The breakdown of much of the old distinction between the political and economic spheres has vital consequences for foreign policy. The closer interdependence of domestic and foreign policy involves a corresponding change and development in the machinery as well as in the personnel for handling these relations.

Besides the formidable combination of material and human resources which a nation must possess to qualify for the onerous role of world power, the broadsheet insists on the importance of capacity for leadership and the moral element in power. If there is any validity in the idea of the twentieth century as the century of the common man, this moral element must become increasingly fundamental to the whole concept of power and its exercise in the modern world. Not the least important task awaiting the framers of our foreign policy is the exercise of imaginative leadership which will ensure the effort required to remedy some of our more intangible weaknesses in this field.

As we must acknowledge the impact of changing conditions on our geographical position, so we must learn to think of ourselves as more than ever a European Power with new and heavy responsibilities in Europe, and the obligation to work out a new and enduring relationship with the peoples of Europe. Further, we must recognize that the conditions of the twentieth century call for a new type of relationship between the advanced and the less-advanced peoples. We have a particular responsibility for working out that relation; we must set out to do so without delay and to apply the results, in co-operation with the other World Powers.

No reader of the considerable volume of literature dealing with international reconstruction can fail to be impressed with the extent to which the consensus of opinion appears to be settling on exactly these principles. Broadly speaking, they are to be found more or less explicitly in Harold Butler's "The Lost Peace" and in Viscount Cecil's "A Great Experiment". They are largely common ground with the argument of Sir Rowland Hill's more recent "Prelude to Peace". There is, in fact, already a great measure of agreement with the view advanced by Political and Economic Planning that common policy and mechanism must invariably satisfy two tests: it must be designed to meet some real and basic need which is common to ordinary men and women everywhere; and it must also be capable of giving concrete results commensurate with men's expectations.

Sir Rowland Hill in his argument goes further than Sir John Williams and faces the problem of neutrality and of the smaller nations which Prof. Carr puts so clearly in "Conditions of Peace". His proposal for a Council of the United Nations is essentially that of building the framework of the new world order out of the institutions set up to win the War itself. That is his first solution to the problem of ensuring that adequate force, on which Mr. Herbert Morrison insisted in his Guildhall speech in February, is behind the institutions of order, though like P E P he relegates to the distant future any idea of formal federation. The essential co-operation between Great Britain and the United States and the U.S.S.R. must be less formal but based on full and an enduring understanding.

This co-operation for world order to ensure freedom from fear must, however, be complemented by the emergence of common purposes and positive, creative policies which will supply the dynamic of the new system. Moreover, national schemes and policies of social security must be framed with the full knowledge of the methods and experience of other countries, and on lines which will help and not hinder similar developments elsewhere. This is one reason why the wider development of the International Labour Organisation is so urgent. It is another reason for obtaining a clear and positive picture of the role we are best fitted to take in the new world balance—the recognition, as P E P points out, that we are now first and foremost a processing and servicing country, earning our living by adding brains and skill to the raw products of the earth; and that our special advantage lies in our exceptionally high level of technical skill, ability for organization and quality of workmanship.

The vital problem now is to educate the country as to what is involved in any policy that can

adequately serve the needs of Britain and her partners in the task of rebuilding the world when the War is won. That task of education should be shared by every citizen who realizes the tremendous issues involved. The Government's part is to strengthen the instruments, such as the International Labour Office or other organs established during the War, by which collaboration can be pursued. Lord Cranborne's statement in the House of Lords on April 15, though in general terms, clearly committed the Government to explore every possibility of strengthening existing organizations and developing new instruments designed to ensure that the new international system based on free co-operation has behind it the overwhelming forces required to maintain the peace.

HIGH POLYMERS

Natural and Synthetic High Polymers

A Text-book and Reference Book for Chemists and Biologists. By Prof. Kurt H. Meyer. Translated by Dr. L. E. R. Picken. (High Polymers, Vol. 4.) Pp. xviii+690. (New York: Interscience Publishers, Inc.; London: Imperia Book Co., Ltd., 1942.) 11 dollars.

SOME twelve years have elapsed since the appearance of Mark and Meyer's book on "Der Aufbau der hochpolymeren organischen Naturstoffe". The subject has since expanded to a very large extent, and the present volume in this series of monographs claims to survey "the entire field of natural and synthetic, inorganic and organic high polymers". In point of fact this is, of course, strictly the object of the whole series of volumes on high polymers, of which this is the fourth volume. The survey must, therefore, be severely restricted in many directions, but none the less, like all the books in the series, it is complete in itself. In a way this attempt at giving a complete treatment tends to some considerable repetition from volume to volume, thus using up valuable space which might otherwise be occupied.

As one might expect, a volume from the pen of K. H. Meyer is mostly devoted to the chemistry of the natural high polymers. The chemistry of these substances is the main and most valuable feature of the book, which is concerned with the structure and reactions of high polymers and not with their synthesis. The opening chapters deal with the principles of the methods of investigating high polymers by X-ray analysis and by the behaviour of their solutions. Similar topics have been discussed in detail in volume 2 of the series, where the reader must go in order to get an account of the techniques involved. This particular part of the volume might, therefore, have been transferred to volume 2. Inorganic polymers are given an appropriate section wherein existing knowledge is summarized. One result of the recognition of the essential polymeric nature of substances, like certain varieties of sulphur and of phosphorus, has brought to an end long-standing controversies by inorganic chemists regarding the size of the molecular aggregates comprising these solids. This result is unambiguously arrived at solely by X-ray analysis of the structure of the solid. Some space is also devoted to the silicates, more with the object of showing how in inorganic chemistry there is a complete set of polymers analogous to organic materials obtained synthetically and existing naturally. It is a controversial point whether silicates should find a place in a book of this character. No mention is made of that interesting class of polymers lying, in a way, intermediate between organic and inorganic chemistry, namely, the products obtained by the hydrolysis of the methyl silicon chlorides.

More than 130 pages are devoted to high polymers, excluding cellulose and the proteins, a large part of which is already adequately treated in volume 3 of the series. But in this discussion there is much that has not appeared elsewhere. For example, the structure and reactions of natural and synthetic rubber are discussed in some detail, as is the thermodynamic theory of the high elasticity of such polymers. While all this discussion is relevant, the reviewer would suggest that in the near future a volume might well be devoted to the scientific, rather than the technological, treatment of this important branch of polymer chemistry. Considerable compression has been necessary to get a description of polyesters, phenol and formaldehyde resins and the products of polycondensation reactions in a matter of twenty pages, which is too condensed to be useful.

All this material none the less forms a useful introduction to the real purpose of the book, namely, a most thorough and illuminating survey of the chemistry of cellulose and its derivatives and of proteins. In so far as cellulose is concerned, the author is at once confronted with the difficulty that science and technology are intimately bound up with each other. Another volume is promised on cellulose, presumably on the technological side, and consequently Prof. Meyer has confined himself strictly to the chemistry of cellulose and the derivatives obtained by chemical and also mechanical treatment. This discussion naturally paves the way for an examination of that enormous variety of substances related to cellulose but not hitherto subjected to the same detailed scrutiny. Starch, chitin, hemicellulose, pectin, lignin and gums come within this category. It is here that close collaboration between chemist and biologist is most likely to clear up many of the ill-defined points of view held about the structure of such materials.

In the section on the proteins a very broad treatment is given. There is only brief mention of the methods of determining molecular weight, which in any event has been dealt with adequately in a number of publications. The structure and reactions of fibrillar and globular proteins is discussed at some length, with due emphasis on the high polymer point of view. The electrochemistry of protein solutions—once a part of classical colloid chemistry—automatically finds its place in this section of the book. Of more interest to the biologist are the sections on conjugated proteins, proteins with enzymatic properties and the various virus proteins. There is a break in the arrangement of the book at this stage, and the sequel to the natural high polymer section is found in the last chapter on the molecular structure of animal and plant tissues, or rather the submicroscopic morphology of such tissues. For want of information, the chapter is necessarily short; but it is the point at which the biologist will be able to start using the data and ideas presented in the remainder of the book in order to make his contribution to the solution of these structural problems.

The interlude mentioned above should have been transferred to the beginning of the volume, since it

deals with the properties of solutions of high polymers in general. It overlaps, but is complementary to, a somewhat similar chapter in volume 2. The main topics are, of course, the solubility, vapour pressure and osmotic pressures of their solutions, since the separation of heterodisperse polymers and the estimation of molecular weight can only be confidently carried out provided there is in existence a sufficient amount of knowledge concerning these solutions. The viscosity of dilute solutions is also a relevant topic here. A critical and extended discussion on this phase of the work would have been welcome. The Staudinger equation has come in for a good deal of criticism, often uninformed, and it would have been extremely useful for the many who are forced to employ this method for measuring molecular weights, out of convenience, to have had a critical summary of this very controversial subject.

In short, therefore, this volume is a mine of invaluable information and suggestive commentary on high polymer systems, especially in those regions of contact with the biological side. For the biologist it is appropriately complete in itself; for those interested primarily in high polymers the other volumes in the series will satisfy all reasonable needs where volume 4 is somewhat abridged. The work of translation has been excellently done by Dr. L. E. R. Picken. The author, translator and publishers alike must be accorded a word of gratitude for having produced, under most difficult international conditions such a valuable addition to this series of volumes.

H. W. MELVILLE.

VENEREAL DISEASE IN GREAT BRITAIN

Venereal Disease in Britain

By Sydney M. Laird. Pp. 80. (Harmondsworth and New York: Penguin Books, Ltd., 1943.) 9*d*. net.

DR. SYDNEY LAIRD'S views on the subject of control and compulsion as a means of reducing the incidence of venereal diseases have already been presented by him to his colleagues in venereology. His expressions can be taken as a fair cross-section of specialist medical opinion. This book is a statement of facts and an appeal to the reader to apply the knowledge he can obtain in his reading to the task—his public duty—of helping to reduce the amount of venereal diseases. Elimination of the stigma attached to the diseases must accompany the newspaper and radio drive to increase the public knowledge of the subject. A short outline of the historical background precedes a simple explanation of the common signs, symptoms, and complications of gonorrhœa and syphilis. A typical case history illustrates the train of events which follow when an ignorant man is exposed to infection. The reviewer can vouch that the example chosen is no unlikely theoretical case.

The treatment of venereal diseases by well-meaning but uninstructed general practitioners—increasing since the advent of M and B 693—is justly decried.

Venereal diseases are not notifiable in Great Britain. Free diagnostic and treatment facilities are provided, but the sufferer must voluntarily present himself, and if he defaults from treatment while still infectious there is no way of compelling him to return. This voluntary system has had a very long time in which to prove itself, and the 70 per cent increase in the incidence of early syphilis since 1939 has proved its complete inadequacy to deal with the present situation. Regulation 33B aims only at a very small section of the community and is unlikely to make a noticeable impression.

The successful Swedish venereal disease control system is described. Treatment is compulsory, but facilities are free both for out-patients and for in-patients. Notification does not disclose the patient's name. The source of infection and any contacts of the infectious person can be compelled to attend for examination and for treatment if necessary. Legal powers are available to deal with anyone who defaults from treatment while still in an infectious state. In practice 97·5 per cent of cases attend until they are certified free of venereal disease in a communicable form, and legal intervention is very rarely needed. Compare this with an instance in an English clinic—a fair specimen—where 50 per cent of syphilis and 30 per cent of gonorrhœa cases defaulted before treatment was complete.

Dr. Laird asks for education of the public and for compulsory powers run on the Swedish pattern, which will, of course, rarely be used in an enlightened community. The medical facilities are already available and adequate.

Finally, there are some illustrative statistical tables, British and Swedish, and a résumé of the relevant clauses of the Swedish anti-venereal laws.

The first half of this book should interest and inform any lay reader, and it is to be hoped that the second half will have the author's desired effect of stimulating the intelligent reader into individual effort in helping to stamp out venereal disease.

PROTECTION OF ELECTRIC POWER SYSTEMS

Automatic Protection of A.C. Circuits

By G. W. Stubbings. Third edition, revised. Pp. viii+320. (London: Chapman and Hall, Ltd., 1943.) 18*s*. net.

THERE are not so many text-books on circuit and machine protection that the present edition of the author's well-known work is not welcome, especially as it has been brought right up to date. The potential power in modern rotating machinery and transmission circuits is so great that one need not wonder at the simplicity and robustness of the design, maintenance, and testing of the apparatus which is relied on to prevent a major disaster on a fault developing and spreading. At the same time that faulty elements in a system are de-energized by the protection system, it is evident that power must be maintained in as much of the rest of the system as possible. The author therefore outlines the development of protection, the design and interconnexion of the necessary voltage and current transformers, and gives a full description of the relays necessary for the sequential or distance control of the circuits to be protected. A chapter on symmetrical components is given so that protection schemes depending on this conception may be the better appreciated. The author concludes his useful survey with an account of the protection of plant, testing, references to relevant literature, and a glossary of the technical terms used in the art. The stability of power supply in Great Britain and the rarity of major breakdowns is the result of the careful application of this protection technique.

L. E. C. HUGHES.

MENTAL ATTITUDES IN WAR-TIME

THE programme of the general meeting of the British Psychological Society, recently held at Oxford, contained a symposium on "Mental Attitudes in Time of War". Prof. Millais Culpin and Prof. Gilbert Murray took the chair in succession.

Dr. R. H. Thouless spoke on "Hatred of the Enemy". One of the social and psychological results of the situation of being at war is the development of an attitude (or sentiment) of hatred of the enemy. In this sentiment there are the characteristic emotional dispositions of hatred, leading to anger at the enemy's successes and joy at his misfortunes, and the corresponding behaviour impulses to injure and destroy the hated enemy. The existence of such a system of emotional dispositions is not peculiar to this War, but is a feature of all wars; it was strongly developed against the Boers in the South African War and against the French in the Napoleonic Wars.

While this hatred is undoubtedly fostered by propaganda during any time of war, there is no reason for supposing that it is simply a product of propaganda. There are undoubtedly internal causes previously at work in people's minds which serve to make the propaganda of hate effective. The internal causes which have been principally considered by psychological writers have been the instinctive or unconscious forces of human aggressiveness. Upon these, however, have been built a structure of fully conscious ideas which may be strengthened or weakened by the use of conscious methods.

The social psychologist must ask himself if in war-time the sentiment of hate is desirable or undesirable; not only whether it attains immediate special and political ends but also whether it is reasonable and good in itself, that is, furthers permanent social well-being.

On one obvious ground, hatred of the enemy can be defended, namely, its service towards the important and desirable end of defeating the enemy by strengthening the intensity of war-effort and providing a motive for enduring the hardships of war. Against this social gain must be balanced serious social and psychological losses. First, war is a transitory pattern of behaviour, succeeded by the relatively lasting pattern of peaceful co-operation. The continuance of the hatreds of war beyond its end, and their effect on the subsequent peace treaties, is a powerful factor in producing the next war. Secondly, belief in the legend of the hated enemy, which is the conscious aspect of the impulse of hatred, produces an irrational picture of the enemy as altogether evil, with refusal to discriminate between good and bad individuals within the hated group. Examples are Hitler's condemnation of the hated Jews and the condemnation of all 'Germans' by some speakers and writers on our own side. It involves a failure to face the real facts of the war situation, and may be a barrier to our taking advantage of the enemy's disunity. A third way in which hatred of the enemy interferes with a realistic attitude towards the problems of making a lasting peace is the tendency to regard the present hated enemy as the one menace to world peace in the past and in the future. History may show that the hated enemy of the moment was a valued ally in the struggle against another enemy in the past (as were the Prussians in the Napoleonic Wars) and that the aggressor of twenty years hence may be some nation other than the present enemy. The attainment of a lasting peace cannot, therefore, be expected to be achieved by the mere defeat and disarmament of the present enemy.

The practical results of hatred in prolonging bitterness and making difficult a satisfactory peace may be regarded as secondary consequences of the fact that hatred is evil in itself—a regressive attitude which blinds judgment and leads to the evil consequences of harsh peace terms and continued bitterness between nations. If, as social psychotherapists, we consider the question of attitudes in war-time, we must condemn hatred and try to devise means for reducing its strength. The unconscious causes of hatred are largely beyond our control; but rational analysis of the legend of the hated enemy can show that much of it is without basis in fact.

There seems insufficient ground for supposing that this process, if successful, need lead to any reduction in effective effort towards winning the War, for effective action need not depend on irrational impulses. There are rational as well as irrational grounds for desiring an Allied victory in the War. Irrational hatred of the enemy is generally least strong among front-line fighting troops, probably because these do not suffer from that frustration of the impulse to action against the enemy which raises the sentiment of hatred to pathological intensity. One difference between this War and that of 1914–18 is that there are now far more active participants in the War and therefore fewer people whose aggressive impulses are frustrated. This gives reason for hoping that there will be fewer irrational haters.

Prof. T. H. Pear discussed the psychological implications of "Re-educating the Germans" after the War. Relevant questions were: Which Germans? How? By whom? For how long? If the re-education is to follow a plan, its form will ultimately depend upon the attitude which a small group of leading men has taken up during, as well as immediately after, hostilities. The Nazi youth is a nasty bit of work, but he is a bit of work; and that work was planned. Perhaps some of its methods might be used to achieve results more desirable to us.

Who are "we"? In 1918–19 "we" appear to have been a group of tired men dominated by some who were less tired. To them, perhaps, there seemed to be no means of ascertaining public opinion except by an election. If other means had existed then, it is doubtful if they would have been used. It is difficult, for example, to believe that leading economists advised the Allies that the sums of money demanded by them could be paid.

Psychologists have a duty as well as a right to think psychologically about problems which concern the lives and happiness of millions, and to comment upon the use or misuse of specifically psychological concepts by persons in responsible public positions. If, only a few weeks ago, psychologists had asked, "On what occasions have our spokesmen, when attempting to influence the public on problems concerning the future of the Germans, used psychological terms?" one answer would have been, "On the radio—but not on the Home Programme. At home, through more than half a million copies of 'Black Record'". This brilliantly written and intensely interesting pamphlet distorts history, ethnology, sociology and social psychology in a manner which Dr. Goebbels has made familiar. Lord Vansittart's point of view is that of an extremely small section of English society. He makes practically no reference to the German working class.

On behalf of the Government, however, Lord Simon asserted in the House of Lords on March 10, 1942, that the Hitlerite State should be destroyed but that the whole German people is not thereby doomed to destruction.

No responsible social psychologist, Prof. Pear believes, would claim that the Germans have a special innate tendency to cruelty, possessed by members of no other nation. A particular type of education seems to have been responsible for the abominable behaviour of the Nazis. It is just conceivable that a relatively larger number of Germans than of other 'civilized' nations might have inherited a temperament specially conducive to learning the technique of cruelty, yet selective breeding to that end would take a long time, and so far would have produced no children above the age of ten. An individual's pugnacious tendency might express itself in bestial cruelty, if intelligently trained in selected techniques or merely in sports like boxing and football which are usually admired.

Prof. Pear suggested that Prof. Gordon W. Allport's doctrine of a relatively undifferentiated human drive* later modified by attitudes, sentiments, complexes, techniques, values and interests, explained the facts better than any appeal to a theory of human instincts. Allport considers that the many known facts about animal instincts only confuse the issue, because there is such flexibility in the human learning and breaking of habits, and so much insight, foresight and delay in responses, that human goals are of a different type from the stereotyped goals of animals. In the process of maturing, the dispositions of childhood coalesce into sharper, more distinctive systems of motivation. As they emerge, these personal, unique systems take upon themselves effective driving power, and operate as autonomous motives, different in aim and character from those of juvenile years and very different from the crude tensions of infancy. Blanket terms like 'aggressiveness' confuse too many psychological problems at present.

Prof. Pear deprecated some spatial metaphors in psychology, in such phrases as 'the *layers* of the mind', 'the *depth* of aggressive instincts', 'the cultural *and therefore more superficial* aspects of the individual in relation to society'. A pattern of activities which began because it was prompted by some comparatively primitive incentive may set up a stranglehold in its own right: stamp-collecting and bridge are good examples. The concept of the transformation of human motives seems to him to be most helpful. In war, too, many motives other than the unconscious ones are deliberately harnessed by authority. The desire for money or fame, the wish to obtain approval and to avoid disapproval from those one loves or respects, may be completely conscious and yet may inspire difficult feats. Both the fighter's and the scientist's activities may also show functional autonomy both in peace and war, complicating the problems of post-war reconstruction.

Dr. Ranyard West asked, "What ought we to Think?" He emphasized our large and increasing knowledge of mental attitudes peculiar to certain character-types within all societies. In particular, he stigmatized the role of the 'obsessional' or 'aggressive-obsessional' character both in pre-war and in war-time society. By virtue of the peculiar powers of hatred and passionate loyalty and devotion which the psychoanalyst now knows them to possess, these individuals are prone to the "black and white" type of thinking which war fosters and which fosters war. But in war-time, obsessional mechanisms of thought also become more apparent among normal men and women. The hideous injuries that in war-time must be suffered by our friends and inflicted upon our enemies virtually give us only two alternatives to "black and white" thought. One is to repudiate aggressive thought and action from religious motives. The other is to understand the inevitability of human prejudice in the presence of emotion. This leads to concentration upon the faulty situation itself.

Racial prejudice has been analysed by Stratton. He finds it nearly or quite universal. But he also claims that it has no innate direction. Nowhere, for example, have white children a 'natural' prejudice against a coloured nurse. It arises not because of any awareness of a difference of race, or even of strangeness, but always because of a feeling of group menace. It is proportionate to the social injury which one race-group believes another may do to it. The physical and cultural characteristics of the hated race thus become merely the signs and badges of an opposing group. The prejudice is a group-reaction to losses threatened or experienced, not inborn, but continued by tradition and by fresh impressions from new harm received.

This analysis transfers the 'racial' problem from a biological into a politico-economic category; and here the present custodian of the race is usually the nation. Nationhood is based upon many factors: geography, language, economy, a common heritage of history and habits. But above all there must be a common interest appreciated as such. "A nation is made and kept by an emotionally sustained education in nationhood. . . . And warfare among civilized nations is no mere persistence of something inborn, but a product and instrument of governmental art." Some of us to-day may be willing to substitute the less ambitious word 'action' for 'art'.

Here we have a welcome emphasis upon contemporary and controllable factors. Our national group-prejudices have their deepest root in the mere group. But in fact the nation State is a very peculiar group, a 'power' group which claims 'sovereign independence' from all other power-groups. The nation binds us first by fostered sentiment and traditional education and common interests. Secondly, it denominates a 'State' which monopolizes collective force within the nation. To the internal power of this State is now conjoined an external aspiration which is essentially undefined and unlimited. The doctrine of 'sovereignty' demands that the nation State itself shall both define and judge its own cause at the one and the same moment—and that moment will be one of intense emotional tension. In final paradox, both the limitless aspiration and the claims of sovereign independence exist in the presence of a real and severe limitation of external power. It is scarcely surprising that our nations come to fear each other.

Dr. West emphasized the fact that the human mind is endowed with ample machinery for maintaining its self-respect but with none for making accurate moral judgments in the face of emotion. He claimed that the distortion of factual judgment, inevitable between individuals, is increased between power-groups (1) because the prejudices become shared, and (2) because they lack the factual correction of third-party judgment and of law. "We have to face the fact that our enemies and we are judging our mutual

* "Personality: A Psychological Interpretation" (Constable). Cf. Pear, T. H., "Are There Human Instincts?" (Manchester University Press (1*s.* 6*d.*), and *Bull. John Rylands Library*, **27** (1942).

relationships by a totally different set of 'facts' stretching backwards into the past, as if we saw only the green in a landscape and they saw only the red."

The inevitable prejudice of human judgment finds a corrective in a natural love of justice. But this corrective requires (1) organization and (2) external application. The requisite institutional remedy lies in law, such as we already have it within our nation States. The inevitability of national prejudice requires that such law shall be organized and administered upon a supernational plane.

PHYSICS, MATERIALISM, AND FREE WILL

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SIR JAMES JEANS'S recent book, "Physics and Philosophy", has once more raised the question of the bearing of the 'new physics' upon the philosophical doctrines of metaphysical materialism and human free will. It is not a little odd that at a time when some philosophers are beginning to wonder whether it makes sense to say that materialism is true (or that it is false), and whether, therefore, it makes sense to say that idealism is true (or that it is false), some eminent physicists and mathematicians are asserting that the new physics provides arguments that are very strong, even if not conclusive, in favour of establishing the truth of metaphysical idealism. Thus, for example, Sir James Jeans concludes: "Modern physics is not altogether antagonistic to an objective idealism like that of Hegel"*. He further contends that the new physics has an important bearing upon the problem of free will.

These two contentions formed the main topic of discussion at the symposium held at a joint meeting of the London and Home Counties Branch of the Institute of Physics, the Aristotelian Society, and the Mind Association, on May 19. I gave the opening paper, which was replied to by Sir James Jeans; Mr. R. B. Braithwaite and Prof. E. T. Whittaker opened the discussion which followed. This article is not a report of the discussion, but an attempt to bring out the main points that were raised.

There is a preliminary question which usually receives far too little discussion, namely, what exactly is the relation of physics and philosophy. Not all philosophers would give the same answer to this question, nor would all physicists. What Sir James Jeans's answer would be is well known; he holds that metaphysics is literally 'beyond physics', so that the decision whether materialism is true or is false is one to be made by physicists. Since it is assumed that the denial of materialism entails the assertion of idealism, it can scarcely be maintained that the physicist *qua* physicist has a right to the last word. Before that last word is said, he must have become a philosopher and have acquired some skill in thinking philosophically. It is also desirable that he should have learnt to avoid the mistakes of earlier philosophers, which have been quite decisively refuted. Certainly any man of science may well be led to reflect upon certain great problems which have traditionally occupied the attention of philosophers —man's place in the universe, the ultimate nature of things, of matter and of mind, and of their interconnexion. Such problems have also exercised the minds of some great poets. In what sense these great questions are 'problems' can only be asked at a comparatively late stage of philosophical development. Physicists are sometimes tempted to take short cuts and to say more than they know.

Prof. E. T. Whittaker has made a very pertinent comment in this connexion. He ascribes the extraordinary popularity of the writings of Sir Arthur Eddington and Sir James Jeans not to their eminence as men of science, nor to their powers of exposition, but to the fact that, as he said, "they have a quality which is found, perhaps, most markedly in great poets, of having flashes of insight which reveal to them things which are beyond the range of exact knowledge. Whereas, knowing them to be eminent scientists, we imagine that what we are going to get from them is exact knowledge, we are delighted to find that they have a poetic insight."* This comment seems to me to be just. To keep to the case of Sir James Jeans, his philosophical reaction to 'the implications of the new physics' appears to be largely determined by his feeling that "the new physics shows us a universe which looks as though it might conceivably form a suitable dwelling-place for free men, and not a mere shelter for brutes—a home in which it may at least be possible for us to mould events to our desires and live lives of endeavour and achievement". These are not the remarks of a physicist writing physics; they are the reflexions of a physicist who is attempting to formulate a philosophy of life. It is from this point of view that they must be judged; criteria derived from physics will not suffice.

The old physics (that is, classical physics, which reached its consummation in the nineteenth century) is thought to be inimical to our desires because it is taken to involve the doctrine that the ultimate reality is matter and that mind is a mere epiphenomenon of matter. This doctrine has been associated with a strict determinism, that is, with the view that all events, including human volitions, are causally connected so that our thoughts and feelings could, in principle, be predicted; everything that happens is, in fact, nothing but a mere re-arrangement of the atoms that are the ultimate constituents of the universe, and alone are permanent. The 'prison-house' feeling, or what T. H. Huxley called "the nightmare", has been induced by the reluctant acceptance of materialism in this form together with the strict determinism associated with it.

Anyone who has accepted this metaphysical theory as an inescapable outcome of classical physics will be likely to welcome the new physics as being very relevant to the solution of his problem. It is, however, important to be clear with regard to what exactly the problem is. It appears to be the problem of escaping from the 'prison-house' into a world in which we may hope "to mould events to our desires". If the obstacle to this escape has been the acceptance of the view that the universe 'really' consists of indestructible atoms and that the perceptible variety of things in the universe and the perceptible difference between men, brutes, and, for example, rocks, are

* "Physics and Philosophy", p. 204.

* I quote from a verbatim report of the discussion, kindly provided for me by the chairman of the symposium. Prof. Whittaker went on to say that I had not altogether allowed for this fact. I think he is right in stressing this difference of temperament, and in insisting that I am not in the least 'poetic'. It would be interesting to learn whether Sir Arthur and Sir James are content to regard their excursions into philosophy as mainly poetic in quality.

wholly due to differences in the arrangements of these atoms, all of which move in accordance with strict causal laws, then the possibility of escape begins to appear promising. The new physics has shown conclusively that this atomic conception is mistaken and that, to quote Prof. Whittaker, "determinism does not reign definitely in the physical world".

It is at this point that the philosophy of Sir James Jeans becomes significant. His contention is that there is a new dualism of waves and particles replacing the old dualism of mind and matter. Readers of NATURE will not require any exposition of this view. Philosophers will wish to ask why exactly Sir James Jeans holds that the 'wave-picture' is more fundamental than the 'particle-picture', and what is the logical basis of his contention that the waves are mental and the particles material, or, as he also puts it, that the wave-picture gives us *knowledge* and the particle-picture gives us *objects*. Further, on what grounds does he contend that the waves control the particles ; hence that mind controls objects ?

In claiming that the wave-picture is mental, Sir James Jeans seems to have been influenced by three considerations : (1) that the geometrical representation of the waves is more complicated than the geometrical representation required by classical physics ; (2) that wave mechanics is a mental construct whereas particle mechanics either is not a mental construct, or at least is not a mental construct *in the same sense* ; (3) that since the waves are waves of knowledge, the determinism involved in the wave-picture originates in part at least in our own minds. It is not clear whether Sir James Jeans considers that (2) follows from (1), but it seems that he must have done so. There is not, in my opinion, any good reason for this contention. Wave mechanics is just as much or just as little a construct as particle mechanics. Hence, if idealistic conclusions are to be drawn from the new physics, they could just as suitably be drawn from classical physics ; in fact, they cannot suitably be drawn from either. (3) would appear to be jointly entailed by (1) and (2). Nothing in the discussion or in Sir James Jeans's book shows clearly what exactly are his views with regard to the nature of mathematics. At times he seems to suppose that a mathematical statement is a statement about something mental ; at other times he suggests that "God made the mathematics and man made the rest" (in physics). However we interpret this cryptic utterance, it does not seem likely to support the conclusion that objective idealism is in the main correct.

Plain men, especially during the last two centuries, have been apt to take their philosophy from science, meekly accepting whatever scientific men tell them to believe, and thus they are led to deny the plain facts of their own experience if eminent men of science exhort them to do so. It is odd how easily plain men and scientific men alike forget the nature of the abstractions within which experimental science is carried on. Although plain men find difficulty in recognizing themselves as 'cogs in a machine', they see that, if the universe is a great machine, they must indeed be nothing better than cogs. They forget that physics is concerned with certain features in the universe, to the entire exclusion of other features. Accordingly, the rejection of the machine-image is hailed with delight as freeing us from the 'prison-house'. All this is very understandable, but completely without logical foundation. If this be correct, the bearing of the new physics upon the problems raised by Sir James Jeans is psychological ; it enables him, and others, to *feel* differently about the position of men in the physical universe. It has, however, no bearing at all upon the question whether metaphysical materialism is false, or whether the assertion that metaphysical materialism is true or false is itself a statement without assignable meaning.

It may further be urged that, even if the new physics destroyed the basis of the nineteenth century denial of human freedom, there would still remain a greater obstacle to overcome, namely, the part played by man's glandular structure upon his activities. This contention, it may be noted, was not favourably received by the physicists.

BREAST AND BOTTLE FEEDING

ABOUT half the babies born in Great Britain nowadays are put on the bottle between the third and sixth months after birth ; the proportion is increasing, but in spite of this the health of babies is undoubtedly improving. It is inevitable that a discussion such as that of the Nutrition Society on May 22 about nutrition in infancy should continually suggest the question : Is there any serious objection to stopping breast feeding after the first few months ?

It is easy to suppose that, through thousands of years of selection, a mechanism has evolved that will provide the baby with ideal food, if the mother is supplied with the necessary materials in her own food. But evolution cannot anticipate changes in environment. Piglets kept in a bare sty become seriously anæmic in a few weeks ; the sow's milk does not supply them with the iron they need, however much she may be taking[1]. In their natural state the piglets would pick up enough by rooting in the earth ; in the sty they must be given iron in some form. Man takes his women and babies into equally unnatural environments which may impose demands that the mother's milk will not cover. The amount of vitamin D that is ample for a naked baby in a sunny climate may be wholly insufficient for a baby screened from ultra-violet light by clouds, smoke, house and clothes. It is possible that artificial milk might be prepared that would meet a modern baby's needs better than any human milk.

The disastrous results of artificial feeding in the past were due to dirt and infection with pathogenic bacteria. Milk supplies were filthy ; bottles were not clean, often because they were so shaped that it was not possible to clean them ; the baby drank an infusion of bacteria, dead or alive. Even if the bacteria were not pathogenic they did not agree with baby. In the last twenty years milk has become cleaner ; much that is now supplied to cities is pasteurized ; the pattern of bottles has improved and mothers have learned how to use them ; house-flies have almost vanished with the horse from cities. These changes have taken away most of the terrors of bottle feeding and of the first few months after weaning. Nine years ago, Grulee[2] published figures to show that the death-rate of bottle-fed infants was nearly ten times as high as that of the breast-fed. But that was more than nine years ago and, as was pointed out at the Nutrition Society's meeting, Grulee made his investigations among the slum population of Chicago. The "slum population of Chicago" may not be so bad as it sounds,

for Chicago had a remarkably low infant mortality-rate. Also the milk used was liquid milk; dried milk would have been safer. In this instance the conditions and method of artificial feeding were at fault. With improvement of social conditions and of methods many of the objections to bottle feeding disappear.

There remain the differences in the composition of human and cow's milk. Cow's milk contains less vitamin C and, if diluted, less A and D. However, some of the worst cases of rickets that are seen nowadays are among breast-fed babies. Both breast- and bottle-fed babies can now get fruit juices and cod liver oil that supply more of these vitamins than they could get from their mother's milk; so there can be no objection to artificial feeding on this score. Even if diluted, cow's milk supplies more riboflavin than does human milk. But calves grow faster than babies; cow's milk is more a growth and less a maintenance ration than human milk; it contains a higher ratio of protein to calories. Also the protein of cow's milk is mainly casein, while two thirds of that of human milk is lactalbumin. In the past, stress has been laid on differences in the amounts and physical properties of these proteins. Cow's milk has been diluted to reduce the protein concentration; cream and sugar have been added to keep up the caloric value; citrate also might be added to prevent clotting. But it is doubtful whether the baby is interested in physical properties; it was the bacteria, not the clots, of cow's milk that its stomach resented. After digestion, proteins are equivalent to mixtures of amino acids. Human milk and cow's milk, diluted to the same protein concentration, differ significantly in the amounts of certain of the amino-acids that they supply. This difference in proportion may affect the synthesis of proteins in the rapidly growing organism. Jeans[3], on the basis of the studies of Catherwood and Stearns[4], considers that babies that are given cow's milk in quantity sufficient to cause a high nitrogen retention have a larger muscle mass than breast-fed babies; although the breast-fed babies appear to be at no disadvantage owing to their lesser amount of muscle. If an artificially fed baby retains no more nitrogen than a breast-fed baby, its motor development is less good. The quality of the muscle seems to depend on the amino-acids of the milk. The evidence is not conclusive; but these studies suggest more sensitive tests of the biological value of proteins than are afforded by measurements of nitrogen retention and gain of weight. Further studies might be made on other animals or on identical twins.

A point that was stressed at the meeting was the importance of giving a baby enough food. Here artificial feeding has the advantage; for whereas human milk varies widely in composition and amount, cow's milk has a relatively constant composition, the amount given can be measured and can be increased if necessary. Forty years ago, when breast feeding was more common, one of the standard jokes was that of the baby that cried at night. The joke is now unfashionable; may it not have lost its appeal because mothers who cannot satisfy their babies now give them a bottle and have a quiet night?

It is usual to ascribe the adoption of bottle feeding to selfishness and laziness. But breast feeding is far less troublesome even than careless bottle feeding. The investigations made in Birmingham by the British Pædiatric Association showed that only 11 per cent of women gave up breast feeding owing to going to work. The most common reason given for stopping breast feeding is inability to satisfy the baby. This takes us back to the subject of the previous discussion at the Nutrition Society on "Nutrition in Pregnancy". The Toronto workers found that 86 per cent of well-fed mothers, but only 59 per cent of those on a poor diet, were suckling their babies six weeks after delivery. The ability to feed the baby well may be one of the best criteria of adequacy of the mother's food. After delivery the involuntary sacrifice of the mother to the baby is less complete than before; the milk begins to deteriorate before the deficiency of the diet becomes extreme. Yet, the demands on the mother are heavy; Ellison and Moore[5] have estimated that the total drain of vitamin A during nine months lactation amounts to 300,000 international units. The average figures given by Dr. Kon imply a daily loss of some 1,000 units of vitamin A and, in winter and spring, 17 mgm. of ascorbic acid per day—a considerable fraction of the vitamin A and more than half the ascorbic acid provided by the day's food. The milk supplies some 400 or 500 calories per day. If the mothers continue on a diet no better than those of pregnant women which were collected by McCance, Widdowson and Verdoe-Roe[6], it must be almost impossible for them to continue, day after day, to spare so many calories. The fashion of disparaging and discouraging the consumption of starchy foods, which must provide the bulk of the calories of the food of all but the wealthy, may have made nursing more difficult. It is not surprising that many mothers, voluntarily or involuntarily, fail to keep up this heavy drain on their own nutrition. Prof. Spence fears that this early termination of the natural reproductive cycle might, in the end, have disastrous results. But we have already interfered profoundly with the natural course of reproduction. It may be that earlier departures from Nature contribute to lack of ability or will to suckle babies for more than three months.

Undoubtedly, when clean cow's milk cannot be got, when housing is inconvenient and insanitary or the mother careless or stupid, bottle feeding is dangerous. Without definite evidence that the welfare of baby or mother suffer from artificial feeding, using proper methods and under suitable conditions, the choice must be left to the mother; the duty of public authorities is to recommend the proper methods and see that the conditions are favourable, particularly that the cow's milk is clean. If breast feeding has advantages over bottle feeding, however done, these advantages should be explained by people who seem to the mothers to understand their outlook and difficulties—as Prof. Spence said, not men and childless women; and again conditions must be favourable for the secretion of a good supply of milk. In either case the first essential is to provide a favourable environment—to get rid of slum housing and slum food.

Dr. Magee of the Ministry of Health could claim that a great advance had been made in this direction during the war years. Little can be done, for the present, to improve housing, but the system of food control, the national milk scheme and the provision of cod liver oil have improved the diet of pregnant and nursing women. The poorest can now get, free, more milk than was drunk by any but a few of the richest mothers whose diets were studied in 1937[6]. Dr. Magee's tone contrasted happily with that of a chief medical officer to the Ministry of Health ten

years ago: "It will be realized that with an infantile mortality-rate of 64 per thousand no spectacular improvement can be expected"[7]. In 1942, the infantile mortality-rate in England and Wales fell to 49—lower than in any year before. This in the third year of a major war, with a rising birth-rate, is not merely spectacular; it is an achievement without parallel in history. The newer knowledge of nutrition has been applied and is justified by the results. Dr. Magee justly gave the credit to those who, brick by brick, have built up this modern knowledge. The first part of this meeting may have seemed a tedious fussing about details; but on these details policy must be based. Much remains to be done, particularly on this question of the relation of breast feeding to the nutrition of the mother.

The national milk scheme and provision of vitamin preparations are not isolated benefits to a small section of the people. With the provision of milk in schools and school meals, they are outstanding steps in the general policy of food control which aims at ensuring food according to physiological needs; they may be the beginnings of a future world policy. It seems that the Food Conference at Hot Springs will not descend to bargains to limit production similar to the wheat and sugar schemes of the past, but will fulfil its promise that the peoples of the world will work together to increase production and adjust distribution to abolish want. If so, our achievement in the midst of this War may stand as a record for all time; not because the mortality of infants, breast- or bottle-fed, will not fall far below 49 per thousand, but because a major cause of war will be no more.

[1] Fost, A. S., and Thomas, S. Y., *J. Min. Agric.*, **45**, 452 (1938).
[2] Grulee, C. G., *et al.*, *Trans. Sect. Pædiatr. Amer. Med. Ass.* (1934).
[3] Jeans, P. C., *J. Amer. Med. Assoc.*, **120**, 913 (1942).
[4] Catherwood, R., and Stearns, J., *J. Biol. Chem.*, **119**, 201 (1937).
[5] Ellison, J. B., and Moore, T., *Biochem. J.*, **31**, 165 (1937).
[6] McCance, R. A., Widdowson, E. M., and Verdoe-Roe, C. M., *J. Hyg.*, **38**, 597 (1938).
[7] Annual Report of the Chief Medical Officer of the Ministry of Health for the year 1933, p. 9.

INDIA'S MINERAL RESOURCES

By SIR LEWIS FERMOR, O.B.E., F.R.S.

LIKE the British Association, the Indian Science Congress Association meets annually, moving from one important centre to another; this year the Association met in Calcutta for its thirtieth session. Mr. D. N. Wadia, owing to unforeseen circumstances, created a record by holding the office of general president for a second term. His address as general president during the first of these years was concerned chiefly with the geological origins of India (see NATURE, December 19, 1942, p. 725). His second address (see NATURE, May 15, p. 548) dealt with more general matters, only touching on the mineral resources of India. The president of the Section of Geology and Geography, however, Dr. J. A. Dunn, of the Geological Survey of India, gave an address on "Suggestions for the Future Development of India's Mineral Resources" (*Proc. 30th Ind. Sci. Cong.*, Part II, Section IV, pp. 1–22; 1943). This is a subject of interest to all who have been concerned with Indian minerals, and one that has, therefore, been discussed previously on numerous occasions. Dr. Dunn has, however, devoted so much of his career in India to the survey and study in the field, as well as in the laboratory, of several of India's principal minerals, that his views must be of value.

Any suggestions for the future development of the mineral resources of a country must be preceded by a statistical stocktaking. The fog of war has, however, descended upon India's statistics of mineral production, the latest published review being that for 1938. This withholding of statistics is in contrast to the practice during the War of 1914–18, when the usual reviews were published annually. The necessity for the present statistical secrecy seems doubtful. Dr. Dunn has met the situation, in what will be to some the most interesting part of his address, with a table showing the relative pre-war mineral production of India and of the principal nations. This table shows the relative production of fifty-four metal and mineral substances by India, the British Empire, the United States, the U.S.S.R., France, Germany, Italy and Japan. The production is not shown by actual figures, but by symbols indicating degree of excess, sufficiency or deficiency, the terms used referring, of course, to a country's output compared with its internal needs, excess justifying export, and deficiency causing import.

According to this table, India has world control in mica, monazite and titanium (ilmenite); a large excess of chromite, kyanite and sillimanite, and manganese ore; an excess of beryllium ore, columbite-tantalite, gold and magnesite; and a sufficiency of barium, bauxite, coal, felspar, fuller's earth and bentonite, graphite, gypsum, iron ore, salt, talc and tungsten; whereas supplies of all other minerals are deficient or negligible. Although all would not apply these labels as used by Dr. Dunn, they give an idea of India's position with reference to the world's mineral supplies, and in particular show which minerals she can afford to export, which she needs for internal use, and which she must import if she is to attain and maintain a balanced industrial economy.

The one mineral of which the classification might be altered is gold, in view of the fact that over a long period of years India was a sink for gold obtained mainly by import; and as the Indian output of new gold (from the Kolar goldfield) is a small one, such exports of gold as have taken place since Britain and India left the gold standard have been mainly from hoards of gold previously imported.

Deductions to be drawn from statistics of mineral production, exports and imports, concerning the metal requirements of industrialized countries, are liable to be vitiated, at least partially, by the increasing part that scrap metal plays in modern industry, adequate statistics of which are not published by any country except the United States of America. Dr. Dunn does not refer to this problem, probably because it has not yet arisen to any major degree for India, which has not long become one of the industrially developed nations. The above reference to gold shows that hoards of precious metals such as gold and silver—although not to be regarded as in any sense a form of scrap—play a similar part to accumulations of scrap metal in tending to vitiate deductions concerning the mineral economy of a country based on the study of mineral statistics that do not take account of the existence of accumulated stocks of metals, either as such or in the form of scrap metal available for return to industry.

Dr. Dunn next discusses the distribution of minerals in India, a country that illustrates in miniature the world's unequal distribution of useful minerals. For in India 40 per cent of the total mineral output comes from one province, Bihar, with its large

deposits of coal, iron ore, limestone and mica, and its smaller quantities of copper ore, chromite, bauxite, kyanite and manganese ore. Advocates of the subdivision of India forget the witness of geology and minerals; for all parts of India are economically interdependent, requiring a co-ordinated mineral policy applicable to the country as a unit. Amplifying Dr. Dunn, one may say that from the mineral point of view the effects of the mutilation of the Indian geological unit by the amputation of the Burmese arm must not be enhanced by the additional subdivision of India, without provision for some form of central geological and mineral control.

The major part of this address is that in which Dr. Dunn discusses each mineral in turn with reference to the possibilities of expansion of production and treatment in India, if economically suitable. Quoting the author:

"At least four minerals now mined in India—mica, manganese ore, ilmenite and monazite—are of great importance to the world's industries, but to date almost their entire production has been exported in the unmanufactured state. These minerals must continue to be exported, but it is eminently desirable that much of the manufacturing processes through which they eventually pass should be completed in India before export. Within this country [India] there is nothing to prevent the gradual expansion of the micanite trade from mica splittings, or the manufacture of titanium white from ilmenite, or the extraction of thorium oxide and cerium from monazite, or even the smelting of much of our manganese ore to ferromanganese."

To this Dr. Dunn very wisely adds a rider: "the main problem would be in ensuring that other countries accept the Indian manufactured material in place of the raw material". The danger in such cases always is that an importing country, rather than lose the benefits of treating imported raw materials, would if possible turn to an alternative source of supply from another country, helping its development if necessary.

Among other mineral substances discussed sulphur may be mentioned, for one of the most important industrial requirements of India is an adequate supply of sulphuric acid, the keystone to so much chemical development. Until recently this commodity has been manufactured from imported sulphur. During the present War, the situation has been helped by the development of the natural sulphur deposits of Baluchistan, due to the initiative of Sir Cyril Fox as director of the Geological Survey of India. But the future important source of sulphur in India is likely to be the extensive deposits of gypsum, particularly those of the Salt Range in the Punjab.

In the remainder of his address Dr. Dunn discusses a number of other problems, such as the stimulation of prospecting, geophysical prospecting, and the possibilities of State aid in the development of the mineral industry. He also recognizes that in addition to a national mineral policy there is an international aspect of such policy, and that if India is to take her proper position among the nations she will have to conform to such general scheme of international mineral policy as may emerge from the post-war political framework. The discussion of such a policy has, of course, been initiated by the British Association, and the problem is now under consideration by the Mineral Resources Committee of that body appointed specially for the purpose.

THE SEARCH FOR NEW INSECTICIDES

By DR. J. R. BUSVINE

Ministry of Health Entomological Laboratory

THE amusing definition of a specialist as "one who learns more and more about less and less" does not hold for the specialist in applied science. On the contrary, so far as I have observed in applied biology, it is a curious paradox that concentration on a single problem often requires the widest superficial knowledge of many subjects. For example, for the past three years I have been studying the effect of new insecticides on the louse. That would appear to be a fairly specialized problem requiring merely a familiarity with the biology of the louse and the physical and chemical properties of the organic chemicals proposed as insecticides. Actually the research led to a consideration of such diverse subjects as the psychology of the louse (and to some extent of the infested men who came to us for treatment), the risks of dermatitis from various chemicals and the possible carcinogenicity of oil diluents. The powers of absorption and retention of cotton, wool and cellulose acetate underwear were considered, and practical problems of laundering and dry-cleaning (especially the preparation of emulsions and the use of large centrifuges) came into the picture. Finally, one had to learn a little of such diverse subjects as army hygiene and women's hair-dressing styles.

It will be realized that, with such a bizarre series of ancillary problems, the biologist at work on a special control problem has little time to look for new insecticides; he can only test those suggested by others.

A search for new insecticidal compounds has been carried out since 1932 by the United States Department of Agriculture (about three thousand substances have been tested on a variety of insects). Apart from this, most of the work has been done in the laboratories of industrial firms. Very little of this work is published but, so far as one can judge, it is largely of an empirical nature. That is to say, of the large number of chemicals tested for suitability as insecticides, the majority are chosen on grounds of availability and the others because of chemical affinity to recognized insecticides. The reasons for the toxicity of these established insecticides were not investigated.

Fundamental research on the mode of action of insecticides has been neglected because it is difficult, and therefore slow. Many administrative men, both in industry and in Government departments, consider the work too academic. They pin their faith on systematized empiricism for getting quicker results. Opposing this extremely pragmatic outlook are those who have consistently urged that fundamental work is fruitful in practice. Certainly it must be admitted that the intensive empirical work of the last decade has left us, in war-time, with very few synthetic substitutes for the vegetable insecticides imported from abroad. It would seem that there is a very strong case for extending the fundamental research on insect toxicology.

As has been implied, the way in which insecticides act is very little understood. The subject can be explored by three kinds of investigation.

1. *Quantitative Experiments.* This type of research is, perhaps, easier than the others, because the

appropriate technical and statistical tools have been developed to meet the needs of the empirical work mentioned above. A good review of these methods has been given by Tattersfield[1].

The amount of poison which an insect can tolerate depends on its anatomy and physiology and is a characteristic of the species. This 'resistance' of the insect is greatly dependent on its state of metabolism, which in turn is affected by the environment. By varying the physical conditions and determining the effects on metabolism and on resistance the relationship between the two can be elucidated. In this way Cotton[2] showed the dependence of susceptibility of insects on their respiratory rate.

A great deal of quantitative research aims at measuring the doses of various poisons which will produce a certain toxic effect under standard conditions.

If these 'equi-toxic' doses are compared with the chemical constitutions of the poisons, something can be learnt of the toxicity of different radicals and the influence of structure on toxicity[3,4]. But even more suggestive is a comparison of the doses with physical properties. At first an almost embarrassing number of more or less close relationships were revealed. Lipoid solubility, capillary activity, volatility and molecular size all seem to have some connexion with toxicity.

Some of this confusion is a result of the complexity of poisoning processes. But considerable simplification was achieved by Ferguson[5], who pointed out that many of the physical constants involved were expressions of distribution of a substance between heterogeneous phases. These laws are involved because they govern the transfer of poison from an external phase to its seat of action in the tissues. By the use of chemical potentials as indexes of toxicity, Ferguson proposes a measurement better related to the actual dose in the tissues. This procedure eliminates some anomalies (for example, the 'cut off' in toxicity observed in ascending many homologous series) and it also differentiates sharply between chemically toxic and physically toxic poisons.

Another way of segregating poisons into different types is by comparing their equi-toxic doses to a series of different types of insect. For example, I have found that a range of insects shows the same order of resistance (say: *A*, *B*, *C*, *D*, *E*) towards intoxication by the vapours of a number of fat-solvent liquids. But quite different orders are characteristic of other poisons such as ammonia and hydrogen cyanide (say: *B*, *C*, *D*, *E*, *A*, and *E*, *A*, *C*, *D*, *B*, etc.). A significant fact, which seems to provide a clue to the mode of action, was that the insects displayed the same order of resistance towards asphyxiation by carbon dioxide as towards poisoning by the fat-solvent vapours[6].

2. *Observations on Individual Insects.* A great deal might be learnt from the careful observation of symptoms in individual insects. This type of work is too laborious to attract the attention of the practical entomologists, and the insect physiologist has been preoccupied with normal metabolism. Much remains to be done.

A very significant observation for developing fumigation was made by Hazelhoff[7] when he showed that the spiracles of insects can be kept open by certain concentrations of carbon dioxide. Likewise the application of contact poisons will benefit by the recent observations of Wigglesworth[8] on penetration of the insect cuticle.

Allied to the method of observing symptoms is the examination of pathological damage, particularly by histological means. The lesions produced by pyrethrum in nerve ganglia are evidence of the seat of action of that poison[9].

3. *Mechanical Models.* The experiments of Warburg in which gas exchange and poisoning effects in the living cell were paralleled by a charcoal model suggested the close relations of adsorption, respiratory processes and poisoning.

Quite recently Hurst[10] has used relatively simple physical systems to attempt to explain some observations on the entry of contact poisons. By ingenious artificial membranes and experiments with the Langmuir trough, it seems likely that light will be shed on the penetration of insecticides through the insect cuticle.

A word of caution, however, is advisable in mentioning the inferences to be drawn from mechanical models. As Clark[11] frequently stressed, the living cell is so complex that one must suspect any simple explanations of metabolism or of intoxication.

Fundamental research on toxicity involves some problems analogous to those of the *ad hoc* work. For example, both have to meet the difficulty of getting the poison to the vital spot. When insecticides are used in practice, a heavy dose must usually be employed which may be ten or a hundred times greater than the amount which will kill the insect 'in a test tube'. The heavy dosage is to allow for wastage and to ensure penetration to the insect, which may be buried in grain or hidden in a crevice in the wall. In the same way, the lethal concentration applied to the exterior of an insect is huge compared to the concentration in the tissues. If the practical dose is measured in pounds or ounces and the 'test tube' dose in milligrams, the amount which actually disrupts the metabolism can be reckoned in micrograms.

From what has been said, it is obvious that anything which will improve penetration by the known insecticides will add greatly to their effectiveness. It seems possible that some of the adjuvants or 'synergists' of pyrethrum which are not toxic themselves may act by accelerating entry of that poison. But the matter is little understood at present and the search for adjuvants proceeds quite empirically.

In another way the fundamental research resembles the applied work; both are constantly confronted with non-biological problems. The toxicologist is preserved from social and industrial diversions; his difficulties concern other branches of science, particularly physics, chemistry and mathematics (statistics). Like a barrister briefed for a technical case, he must read the various subjects to acquire a working knowledge. Unfortunately, the questions usually involve rather abstruse sections of the particular sciences. The statistics of toxicity require the special methods of small samples: the physics may concern monolayers or phase distribution; the chemistry is that of unusual compounds with formulæ like the more complex Chinese characters.

The only good solution of the difficulty is by collaboration between biologists and other specialists, if possible working on the same problem; certainly in the same institution. My experience is that half an hour's discussion with an expert is worth several days of poring over heavy treatises on an unfamiliar subject. Most biological research stations employ a full-time statistician for their problems. A physical chemist would probably be equally useful.

This is not to say that specialists should confine themselves entirely to their own subjects. Both parties must know the groundwork of the other subject for a collaboration to be successful. The specialization on insecticides research should resemble mountain peaks connected by ridges and passes, and not the isolated specialization of the branches of a tree. That is probably true for other types of research also.

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PRODUCTION OF MAGNESIUM

MAGNESIUM is to-day a metal of the greatest importance, and the paucity of reliable information regarding the production of this latest addition to the industrially important metals makes especially welcome the survey given by Dr. C. H. Desch in the Peter Le Neve Foster Lecture to the Royal Society of Arts delivered on February 17.

Magnesium, the lightest of all the industrial metals, is a new-comer to metallurgy. Although first prepared by Davy in 1808, it has only become really well known in the course of the present War, though its production had been increasing for some years before.

The pure carbonate is of only local occurrence, though there are very large deposits of a lower degree of purity. The double carbonate of calcium and magnesium, dolomite, is far more widely distributed, and sea water provides an inexhaustible source of the chloride in a dilute form, while certain concentrated solutions of magnesium salts occur in the Dead Sea and elsewhere.

The fact that magnesium alloys are available which are extremely light for a given strength renders the new metal one of great importance in all branches of transport engineering. The output of the United States is planned at a rate of some hundred times that of 1940, but the industry is far from being merely a war-time one and will certainly play a permanent part in both metallurgy and engineering.

The preparation of magnesia from sea water is not new, going back to the early days of the basic Bessemer process, but it is only in very recent years that it has become of real importance. Oceanic water contains about 0·14 per cent of magnesium, and the process is represented by the simple reaction:

$$MgCl_2 + Ca(OH)_2 \rightarrow Mg(OH)_2 + CaCl_2,$$

the relatively insoluble magnesium hydroxide being precipitated. It is, however, often necessary to remove other salts by the addition of lime prior to the recovery of the magnesium, and conditions must be so adjusted that the particles are of such a size as to filter rapidly. By using calcined dolomite instead of lime, the yield is increased.

The earlier methods of reduction of the magnesia by an alkali metal have now only historical interest, but in 1830 Faraday decomposed molten magnesium chloride electrolytically; and in 1852, Bunsen improved this process and thus laid the foundation of that most widely used to-day. There are great advantages in employing a process which yields the anhydrous chloride in one operation; the alternative is to expel water from the hydrated salt, the last two molecules of water in which are retained somewhat firmly, the dehydration then often resulting in the formation of the oxide and oxychloride. This may be effected by taking advantage of the reaction between magnesia, dry chlorine and carbon.

$$MgO + C + Cl_2 \rightarrow MgCl_2 + CO,$$
$$2MgO + C + 2Cl_2 \rightarrow 2MgCl_2 + CO_2.$$

As both these reactions are exothermic, the heat required is not great. The ground magnesia is mixed with carbon in the form of coke or anthracite dust, together with some material, such as sawdust or peat, to make the mass porous, and made into briquettes. Molten magnesium chloride in the anhydrous state is then tapped off from the base of the furnace.

Theoretically, the chlorine process is a cyclic one, the chlorine absorbed in the chlorination plant being again set free in the electrolytic cell. In practice, however, this recovery is by no means complete, a fact which is partly due to the formation of hydrochloric acid with moisture. It is necessary, therefore, both to add chlorine from some other source and to absorb the acid fumes in some sort of washing plant.

Full details of the electrolytic practice are not generally available, but in broad outline this consists of rectangular steel cells with graphite anodes and iron cathodes. The bath of fused salts usually contains chlorides of the alkali or alkali-earth metals in addition to the magnesium chloride, in order to lower the melting point as well as to lessen the decomposition, which is appreciable when the pure salt is kept in the molten state. Fluorides are also sometimes added. On account of the low density of magnesium, it floats on the surface, rendering it necessary to provide for the complete separation of the upper parts of the anode and cathode compartments, in order to prevent contact of the metal and the chlorine produced. The partitions are of ceramic material immersed from above. Large electrodes of good design are also necessary, each cell usually carrying 15–20,000 amp. with a potential difference of 7–9 volts. The bath temperature varies from 670° to 750° C., the energy consumption being about 20 kWh. per kgm. of metal. The liquid magnesium is skimmed off from time to time, and with modern casting and remelting technique a very pure metal is obtained free from the inclusions of hygroscopic chlorides to which corrosion was once attributed.

Attempts to manufacture magnesium by processes similar to that used in the extraction of aluminium have so far proved a costly failure in the United States. The solubility of magnesia in molten fluorides is much less than that of alumina in cryolite, and the salt baths have both a higher melting point and density.

Magnesium being a volatile metal boiling at 1097° C., the reduction of the oxide by a non-volatile reducing agent, carbon, calcium carbide, ferro-silicon, aluminium, etc., and the removal of the metal in the form of vapour has suggested itself to several inventors. The presence of even a small proportion

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Secretary-Assistant required for Technical Library in Essential War Works, ¼-hour from London. Typing essential, previous library experience preferred. No person within the scope of the Employment of Women (Control of Engagement) Order 1943, need apply. Write stating age, experience and salary required to Box W. 743, Willings, 362 Gray's Inn Road, W.C.1.

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of oxide, however, prevents the magnesium from forming a homogeneous mass ; hence it is necessary to work under conditions approximating to a vacuum. Although on the face of it a simple process, the reduction of magnesia by carbon presents many difficulties. The temperature needed is 2000° C. or more, and the reaction is reversible. As the vapour cools, the oxide tends to reform, and even with an efficient condenser and dilution with an inert gas the dust obtained is contaminated with oxide. Using briquetted materials heated in an arc furnace, and cooling the vapour in a jet of strongly cooled hydrogen, by which means the temperature of the vapour is very quickly reduced to about 200° C., the condensed dust may contain only 90 per cent of the metal. Redistillation is required in an atmosphere of hydrogen or natural gas with the filtration of the oxide particles, followed by direct condensation to the liquid state. It is not surprising that the process has proved difficult to carry out and that serious explosions have occurred.

The substitution of calcium carbide for carbon as the reducing agent eliminates the formation of a gaseous product which can bring about the reverse reaction on cooling. The reaction,

$$MgO + CaC_2 \rightarrow Mg + CaO + 2C,$$

is carried out in vertical gas-fired retorts of heat-resisting steel in which the mixture of magnesia and the carbide is heated. A vacuum is maintained, and the metal condenses in a compact form instead of as dust. Reduction with ferro-silicon occurs at a temperature of 1200–1400° C. and possesses the advantage that calcined dolomite may be employed. This process is being developed on a large scale in the United States, where the ferro-silicon can be produced in electric furnaces in scattered plants having a surplus of hydro-electric power.

A process for the reduction of magnesia by aluminium is an interesting example of the application of laboratory high-vacua technique on a commercial scale. The magnesia, obtained from sea water, is calcined, ground and mixed with aluminium or aluminium alloy. Briquetted under pressure, the mixture is charged into crucibles and pre-heated to about 400° C. The crucibles have a downward central outlet leading to the condenser placed beneath. The self-contained unit consisting of crucible and condenser is raised into an electrically heated vertical cylindrical furnace. The furnace is then sealed and heated to 1100–1250° C. under a pressure of less than 4 mm. of mercury. The magnesium distils over into the water-cooled condenser, in which it solidifies as a mass of crystals of high purity ; the mass is readily transferred, on breaking the seal, to the remelting furnace, from which it is cast into ingots. A continuous furnace on the same lines has been designed, and, as aluminium swarf and other reducing agents may be employed, the process possesses great elasticity.

F. C. THOMPSON.

NEWS and VIEWS

Research in the United States

IN a recent statement made by Sir Ernest Simon before the Parliamentary and Scientific Committee, some outstanding facts were given concerning research in the United States. The research unit of the Bell Telephone Company, for example, has some 5,000–6,000 research workers concentrated on the one problem of telephonic communication. In the United States there seemed to be little need to persuade the business man, hard-headed though he be, of the value of research. He is now so firmly convinced by the results of the last twenty years, in peace and in war, of the necessity of research, that expenditure has risen to an astonishing figure, and, during the great depression, the research budget was the last to be cut. In 1940, according to an official report, industry was maintaining some 2,200 laboratories with a research staff of 70,000, at an annual cost of three hundred million dollars. Sir Ernest wondered what the expenditure is in Great Britain ; he doubted whether it was £4,000,000, yet it was to be noted that the United States population was only three times greater than ours. Per head he estimated that the United States were spending five times as much as we spend on university and industrial research. The results were significant. America now leads in hydrocarbon research, the world order being now : United States first, Germany second, Russia third and Great Britain fourth. Yet coal is our only special large-scale natural resource, and success in the difficult post-war period in exporting enough to pay for our essential imports will depend to a substantial extent on the most scientific treatment of our coal in order to get from it the maximum value.

This question of research is, of course, broadly divisible into two parts : research conducted by industrial organizations and research conducted by universities, and Sir Ernest Simon had some equally striking points to make concerning American universities. Their size and number is almost startling. When, during 1937–38, we had about 50,000 university students in Britain, America had a million. Their income was £97,000,000, while ours was just over £6,000,000. American grants from Government authorities were ten times, and from private generosity, twenty times as great as ours. In engineering, for example, there were, in the same year, 12,000 graduates from the American schools compared with about 800 in Great Britain. Now none more than ourselves realize that this comparison either of research or of numbers of universities and students may quite easily be very misleading. There are many factors which need close examination before final and valid conclusions can be drawn. The standards of graduate qualification must be closely examined and more particularly the work done by post-graduate students. The same care is needed when comparisons of arrangements for research are made, for research is a word capable of many interpretations. In saying that, we have no intention of attempting to detract from the vast and expert work of American research organizations and of American universities. By whatever test which may be applied it seems clear, from the points made by Sir Ernest Simon, that America has set and is setting an example which ought, without any avoidable loss of time, to be followed in Britain. The discussion which followed Sir Ernest's statement showed how the problem was appreciated by his listeners and gave indications of where research here should be encouraged and fostered.

Carnegie Trust for the Universities of Scotland

THE forty-first annual report of the executive committee of the Carnegie Trust for the Universities of Scotland (Edinburgh : Carnegie Trust for the Universities of Scotland) covers the year 1941–42. The method of interim distribution begun in the academic year 1940–41 was again employed, the annual grants being subjected to a 10 per cent deduction to safeguard the position at the close of hostilities. It has now been arranged that application for grants for research may be made at any time during the year and will be considered by the Executive Committee at such times as may be found convenient. With regard to assistance to students, there was a decrease of 184 beneficiaries in 1941–42 as against 1940–41, the fall being almost wholly among male students, and the decrease was greatest in the faculty of arts ; in the faculty of medicine there has been an increase, whereas in the faculty of science the figures have remained relatively steady. The year has been noticeable for the number of repayments made by Scottish graduates now abroad. Appendixes include a report upon the work of investigators under the research scheme during the academic year 1941–42, in which reference is made to work on the synthesis of methyl-glucoses and related studies, the attempted synthesis of a bis-isoquinoline derivative with a structure related to that of emetine, to work on the chemistry of penicillin, investigations on the eel-worm disease of potatoes, the reliability of mental tests, and to Dr. A. P. Hickie's work under Dr. W. O. Kermack at the Royal College of Physicians' Laboratory, Edinburgh, on the preparation of pyridoquinoline compounds with a constitutional relation to compounds of known anti-malarial activity.

Further reference to this work is made in the report of the superintendent of the laboratory of the Royal College of Physicians for the academic year 1941–42, which is also appended. Research in the Chemical Department under Dr. Kermack's supervision has been mainly in this field of synthetic anti-malarials. The synthesis of new *m*-phenanthrolines has now been taken up by Dr. W. Tebrich, and work on *o*-phenanthroline derivatives has also been continued and the nitration of 4-chloro-2-methylquinoline has been examined. Good progress has been made in work on the synthesis of derivatives of the complex ring system pyridoacridine, and the preliminary account of Dr. Tebrich's investigations jointly with Dr. J. M. Robson on the penetration of albucid soluble into the ocular tissues of rabbits following local application has already appeared in NATURE (148, 167; 1941). In the Department of Histology, studies of breast cancer have been continued, as well as an intensive study of a remarkable case of generalized sarcoidosis ; and in the Bacteriological Laboratory the search for a basic medium for the cultivation of bacteria has been continued. Lists of publications by fellows, scholars and recipients of grants received since September 30, 1941, and of publications by teaching fellows are also appended to the report, with details of assistance to students and the abstract of accounts for the year ended September 30, 1942.

Sir John Floyer (1649–1734)

A PAPER on "Sir John Floyer and his Times" was read recently before the Johnson Society by Mrs. Lilian Lindsay, honorary librarian of the British Dental Association. Sir John Floyer was born in 1649 at Lichfield, the birthplace of Samuel Johnson, and was educated at Queen's College, Oxford, where he took his M.B. in 1674 and his M.D. in 1686. The course consisted in readings in the medical classics and memorizing the aphorisms of Hippocrates and the works of Galen. Theses were written and were upheld in disputation. There was no clinical teaching or opportunity for practical experience. The more serious students went abroad for this, especially to Padua. In 1686 Floyer was knighted. In 1687 appeared his first book entitled "The Touchstone of Medicines Discovering the Vertues of Vegetables, Minerals and Animals by their Tastes and Smells", which was published by Dr. Johnson's father, in the preface to which he mentions that he had visited the Garden which the Society of Apothecaries had brought in 1671 and was first called the Physic Garden in 1678. In 1697 he published an inquiry into "The Right Uses and Abuses of Hot, Cold and Temperate Baths in England", which contained a history of bathing from the earliest times and showed that Floyer had visited all the available springs, wells and watering places in Great Britain.

Floyer's chief contribution to medicine, however, was his work on "The Pulse Watch" (1707), in which he related how for many years he tested healthy pulses among his patients by pendulum clocks and common watches until he found a minute glass which he used in his experiments on cold bathing. His "Treatise on Asthma", of which the first edition was published in 1698 and the third in 1745, gave the first description of pulmonary emphysema in asthma, from which he suffered himself. In 1725 appeared his "Medicina Gerocomica, or Galenic Art of Preserving Old Men's Health", in which he advocated fresh air, exercise, regular diet and temperance in all things, especially alcohol and tobacco. Two of his contributions were read before the Royal Society, one on the dissection of a monstrous pig and the other on the sweet taste of plants. In conclusion, Mrs. Lindsay remarked that Floyer resembled John Hunter in his passion for experiment but lacked his genius in interpretation and orderly thinking.

Earthquakes Registered in New Zealand

DURING January 1943 only four distant earthquakes were registered by the seismographs at Auckland, Arapuni, Christchurch and Wellington, New Zealand, according to the provisional bulletin just received (Provisional Bulletin No. P–131, New Zealand Seis. Rep., Dominion Observatory, Wellington, N.Z., Jan. 1943). The first earthquake was on January 2. *P* waves were received at Auckland at 19h. 32m. 20s. U.T. from an epicentre 22° distant. The second, on January 9, came from an epicentre some 25° from Wellington, *P* waves arriving at this place at 02h. 20m. 01s. U.T. The third shock was on January 27, possible *P* waves arriving at Wellington at 02h. 58m. 30s. U.T. from an epicentre 95° distant, though interpretation of this record was difficult owing to the small amplitudes being confused by microseisms. The last shock of the month, the epicentre of which was at a greater distance than 10° from Wellington, occurred on January 30. *P* waves were received at Christchurch at 06h. 05m. 40s. U.T. from an epicentre some 53 km. distant. During the month there were in addition twenty-five earthquakes the epicentres of which were at a distance less than 10° from Wellington. All but four of these were felt at some place or other in New Zealand ; two were felt at Wellington, three at Masterton, and

six at Wairoa. The greatest felt, reckoned on the modified Mercalli scale, was on January 24, about Foveaux Strait, where the intensity reached scale V. Greater instrumental magnitudes occurred on January 4 and January 9, though the former only attained modified Mercalli scale III at Ohakune and Taihape, and the latter, from an epicentre some 200 km. distant, was apparently not felt in New Zealand.

Earthquakes Registered in Spain

DURING the month of March 1943, thirty earthquakes were registered by the seismographs at the Observatory at Toledo (Registro de las observaciones provisionales correspondientes al mes de Marzo de 1943, Observatorio Geofisico de Toledo). Twelve of these were sufficiently strong and well registered as to have their epicentral distances determined, and two further shocks had their epicentral distances provisionally determined. The largest shock of the month to be recorded was on March 9. This began with *ePz* at 10h. 02m. 59s. from an epicentre some 11,180 km. distant and attained a maximum ground amplitude at Toledo of 74 μ at 10h. 45m. 47s. The second strongest shock of the month to be recorded was on March 21, which began with *iPz* at 20h. 55m. 09s. and attained a maximum amplitude of 29 μ at 21h. 56m. 23s. The epicentre was 16,000 km. from Toledo. Two shocks, apparently from the same epicentre 9,500 km. from Toledo, had a depth of focus of approximately 120 km. These were on March 14 and 15. The only 'near' earthquake of the month was apparently on March 26. The epicentre was 560 km. from Toledo and the focus was 25 km. deep, but as the azimuth was not determined, other observations are required before the epicentre can be accurately determined.

Invention of the Barometer

THE tercentenary of the invention of the barometer will be marked by a meeting, to be held at the University of Toronto on October 19, arranged by a committee including representatives of the Royal Meteorological Society (Canadian Branch), Royal Astronomical Society of Canada, Royal Canadian Institute and the University of Toronto. Papers will be presented by Prof. L. C. Karpinski on "Telescope, Microscope, and Barometer as a Point of Departure for the Natural Sciences"; Prof. G. S. Brett on "The Effects of the Discovery of the Barometer on Contemporary Thought"; W. E. Knowles Middleton on "Subsequent History of the Barometer"; and Prof. John Satterly on "The Applications of the Barometer in Physics and Chemistry". Correspondence should be addressed to the secretary of the Committee, A. D. Thiessen, 315 Bloor Street West, Toronto, Canada.

Epidemiology of Leprosy

ACCORDING to a paper on this subject by Dr. G. W. McCoy, medical director (retired) of the United States Public Health Service (*Public Health Rep.*, Dec. 18), leprosy tends to disappear from many parts of the world, while in other parts it tends to spread freely. At the present time in Europe the disease spreads apparently only in the countries bordering on the Mediterranean and the Baltic. As regards the United States, in Louisiana, Florida and Texas the presence of imported cases from the British West Indies, Dutch Guiana, South America, China and Chile, has resulted in the establishment of foci in which the disease shows a strong tendency to perpetuate itself, while in the central north-western States, such as Minnesota, leprosy has shown little tendency to become established. In other parts of the United States the disease is so rare as to be practically negligible from the public health aspect. Dr. McCoy concludes that in an age in which great social and economic changes are occurring, it is impossible to predict what effect they may have on leprosy or other diseases.

Deaths from Exposure to Cold

ACCORDING to an editorial in the January issue of the *Statistical Bulletin* of New York, during the eight-year period for which data are available, namely, 1933–41, the deaths in the United States from exposure to excessive cold—freezing, frostbite, etc.—were on the average 363 annually or about 3 per 1,000,000 persons. The highest figure (579) was reached in 1936 when there was exceptionally cold weather over a large part of the country, while the minimum figure of 190 in the period was in 1939. In the United States as a whole, males were the victims of exposure to excessive cold about four times as frequently as females, and two thirds of the male deaths occurred in men of fifty and more, many of whom were probably suffering from arterial diseases and therefore more susceptible to the effects of exposure. The highest rates in the country were found in the mountain States of Nevada, Montana, and Wyoming, while the district of Columbia was lowest and California came next.

Announcements

DR. W. G. OGG, director of the Macaulay Institute for Soil Research, Aberdeen, has been appointed to succeed Sir John Russell as director of the Rothamsted Experimental Station on Sir John Russell's retirement at the end of September.

SIR LAWRENCE BRAGG, Cavendish professor of experimental physics in the University of Cambridge, and Prof. C. G. Douglas, professor of general metabolism in the University of Oxford, have joined the Council of the Gas Research Board.

DR. E. W. SMITH, president-elect of the Institute of Fuel, has been awarded the Birmingham medal of the Institution of Gas Engineers, in acknowledgment of his outstanding work during the past thirty years for the gas industry. The Birmingham medal was founded some sixty years ago, and has only been presented on fourteen previous occasions during that period.

MR. R. W. PAUL, who died on March 28 (see NATURE, April 24, p. 470), has left the proceeds from the sale of his shares in Cambridge Instrument Company (to be called the R. W. Paul Instrument Fund) to be used for the design, construction and maintenance of novel or unusual instruments for investigation in physical science, and subject thereto to the Royal Institution, the Physical Society and the Royal Society; and on his wife's decease £5,000 to the research fund of the Royal Institution of Great Britain, and £500 each to the Benevolent Fund of the Institute of Physics, the Cinematograph Trade Benevolent Fund, and the Benevolent Fund of the Institution of Electrical Engineers.

LETTERS TO THE EDITORS

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

A Quantitative Theory of the Precipitin Reaction

THE theory which follows is, in the main, based on the same fundamental ideas as have recently been employed by several authors[1,2,3,4]. The mathematical treatment, it is believed, is more simple than that of Heidelberger and Kendall, and the results seem to have a more general significance. The principle applied is the same as that governing the dissociation of a weak polybasic acid of the type $H_N^+X^-$, namely, that of 'step dissociation'. The antibody A (corresponding to the hydrogen, H) is assumed to be *univalent* and combines in steps with the *poly*valent antigen G (corresponding to the X ion of the acid with the valency N) to form compounds AG, A_2G . . . to A_NG. All these compounds exist simultaneously, their relative quantities being dependent on the total concentration of G, the concentration of 'free' A and the equilibrium constants k_1, k_2 . . . to k_N, exactly as the proportions of the various anions of the acid H_NX are governed by its total concentration, the hydrogen ion concentration and the N dissociation constants. The simultaneous equilibria are

$$A + G \rightleftarrows AG \qquad \text{(equil. constant } k_N\text{)}$$
$$A + AG \rightleftarrows A_2G \qquad \text{(equil. constant } k_{N-1}\text{)}$$
$$\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot$$
$$A + A_{N-1}G \rightleftarrows A_NG \qquad \text{(equil. constant } k_1\text{)}.$$

It is now assumed that several or all A–G compounds very soon become insoluble. Therefore a necessary condition of the theory is that the final flocculation takes place in such a manner that it does not disturb the equilibria already established. In order to explain the 'inhibition' or the 'post zone', in agreement with Heidelberger and Kendall and others, it is believed that the A–G compounds richest in G (AG and possibly A_2G) will retain a more or less complete solubility. Accordingly, the total precipitate formed will consist of a mixture of the insoluble A–G compounds. These are calculated by aid of the mass-action law which, for the simplest compound AG, gives

$$[AG] = \frac{[A]}{k_N} \cdot [G].$$

By proper substitution the following general expression may be derived for any compound A_nG

$$[A_nG] = \frac{[A]^n}{k_N \cdot k_{N-1} \cdot k_{N-2} \cdot \ldots \cdot k_{N-n+1}} \cdot [G] \quad (1)$$

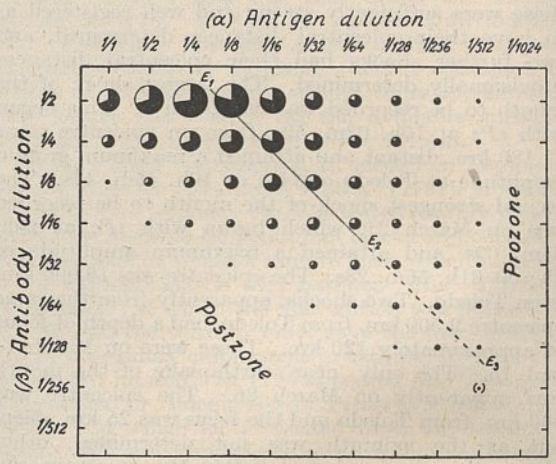
Furthermore, the known total molar concentrations of the antibody $[a]$ and the antigen $[g]$ may be written

$$[a] = [A] + \sum_{n=1}^{n=N} n[A_nG] \quad (2)$$

$$[g] = [G] + \sum_{n=1}^{n=N} [A_nG] \quad (3)$$

The N equations of type (1) together with (2) and (3) supply the $(N+2)$ equations necessary to enable a complete solution for the unknown quantities $[A_NG]$ . . . $[AG]$, $[A]$ and $[G]$ in terms of the known mixed quantities of antibody $[a]$ and antigen $[g]$ and the known dissociation constants k_1, k_2 . . . k_N. The numerical solution is best performed by an interpolation method. This may be somewhat tedious and consists in a successive variation of the 'free' antibody concentration $[A]$ and calculation of the corresponding $[G]$ and $[a]$ or $[g]$, depending upon whether the antibody or the antigen concentration is regarded as fixed and the antigen or the antibody concentration as a variable (corresponding to the 'antigen dilution' and the 'antibody dilution' procedure of immunological practice; compare the α- and β-procedure of Marrack).

A graphical representation of some consequences of the theory is given in the diagram.



The diagram pictures on a true scale a precipitin reaction of a 'quadrivalent' antigen ($N=4$) with inhibition due to complete solubility of the compound AG. Horizontal rows represent α-procedures with the antibody quantity constant, vertical rows denote β-procedures with the antigen quantity constant. The areas of the circles are proportionate to the weight of the precipitates. Precipitates amounting to less than 1 per cent of the largest pictured are not plotted. The black and the white sectors represent antibody and antigen respectively. The following parameters were employed: the dissociation constants were chosen to fit in a 'statistical' order $k_1 : k_2 : k_3 : k_4 = 1{\cdot}6 : 0{\cdot}60 : 0{\cdot}27 : 0{\cdot}10$; the dilution 1 : 1 corresponds to 1,000 concentration units and the molecular weights of A and G are both taken as unity.

The theoretical results are in good agreement with the experimental facts (cf. Marrack, *loc. cit.*, Fig. 23, p. 157). In an antigen dilution procedure, for example, antigen in great excess causes little or no precipitation ('postzone' or 'inhibition zone'); as the amount of antigen is reduced the amount of precipitate rises to a maximum and gradually falls again to zero ('prozone'); as the amount of antigen is reduced the amount of precipitate rises to a maximum and gradually falls again to zero ('prozone'). The characteristic variation of the ratio A to G in the precipitates is also in accordance with many experimental observations (cf. Marrack, *loc. cit.*, Table 24, p. 161). In the special case shown in the diagram, the 'equivalence points' or 'neutral points' (lying in the middle of the zone in which neither antibody nor antigen, or traces thereof, appear in the supernatant fluid, situated on the line $E_1 - E_2$ in the diagram)

very nearly coincide with the maximal precipitations. At the lower A and G dilutions the equivalence precipitation becomes increasingly incomplete (the line $E_2 - E_3$). In other cases, however, particularly in the absence of inhibition due to soluble AG, it can be shown that the equivalence point in a dilution series may appear long before a maximum amount of precipitate is attained (compare, for example, the albumin anti-albumin systems of Taylor, Adair and Adair[5]).

A detailed account of the proposed theory and its application to the antigen-antibody reactions in general will be published elsewhere.

TORSTEN TEORELL.

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April 20.

Heidelberger, M., and Kendall, F. E., *J. Exp. Med.*, **61**, 559 (1935).
[2] Marrack, J. R., "The Chemistry of Antigens and Antibodies" (London, 1938).
[3] Haurowitz, F., "Fortschr. d. Allergielehre" (Ed. by P. Kallós), p. 19–71 (Basle, 1939).
[4] Pauling, L., *J. Amer. Chem. Soc.*, **62**, 2643 (1940).
[5] Taylor, G. L., Adair, G. S., and Adair, M. E., *J. Hyg.*, **34**, 118 (1934).

A Variant of Maxwell's Experiment on the Movement of Magnets about a Straight Conductor

THE experiment described by Maxwell[1] in which magnets are placed on a tray free to rotate about a long straight wire carrying a heavy current is well known. The present variant of this experiment is intented for demonstration purposes, and provides for (*a*) a proof that the forces acting on the magnets are amply large enough to cause a violent movement of the tray if the resulting moment was not in fact zero ; (*b*) the use of current-carrying coils as well as magnets.

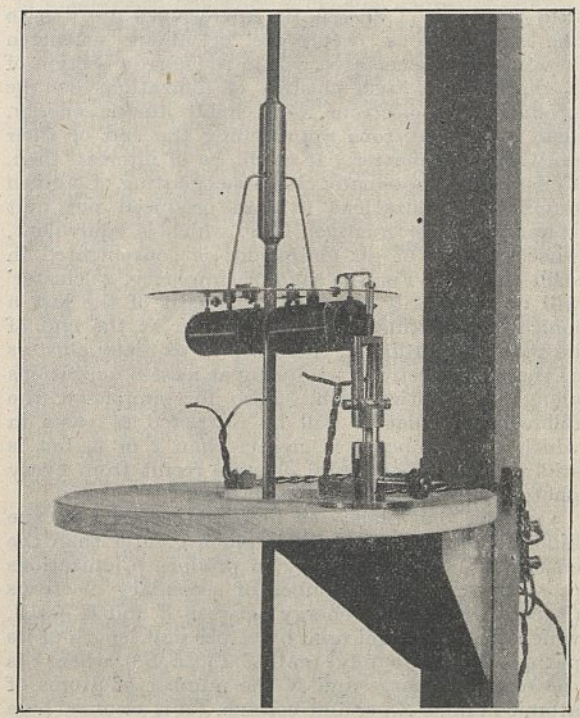
A light metal tray 6 in. in diameter is attached to two arms fixed rigidly to the centre support, which has a hard steel pivot let into each end, these pivots being supported between two jewelled screws carried in a special housing of brass which is made in two halves so as to enable the tray to be pivoted along the axis of the long straight conductor, slots being cut in the housing to allow a rotation of the tray through about 90°. The conductor rod is then screwed into the ends of this housing, and the result is a fairly rigid tray free to move easily about the axis of the conductor. The tray is arranged to carry either the two small magnets or two coils, or both magnets and coils.

When using the magnets, as in the original experiment, one of them rests on small v-guides and the other on a pivot on the inside and a guide on the outside. The latter magnet has also at its outer end a free pivot arranged so that a lifting device standing on a fixed table can be brought up, and the weight of the outer end of this magnet is thus no longer transmitted to the tray. Under these conditions the tray moves vigorously in a direction depending upon the direction of the current in the conductor, the direction of movement being reversed when the current is reversed.

The experiment with the coils is similar. Each coil has 330 turns of No. 30 S.W.G. enamel insulated wire wound in two layers, on a fibre tube $2\frac{13}{16}$ in. long and $1\frac{1}{8}$ in. diameter, and is suspended from the tray by small brass hooks, one hook being extended so as to provide a means of lifting one pole. The current is supplied to the coils by means of No. 40 S.W.G. copper wire with tiny connectors which clip on to rigid conductors under the coils, these conductors being twisted together so that their magnetic field does not affect that due to the current in the straight rod.

When the coils are energized and rest wholly on the tray, there is no movement when large currents are reversed in the vertical wire. But if one end is lifted, the tray is strongly deflected to right or left when the current in the wire is flowing, showing that the forces acting are large enough to be observed unless the resultant moment about the vertical wire is zero.

The lifting device is raised by means of an eccentric and carries an arm pivoted horizontally so as to allow a movement at right angles to the conductor rod as the tray rotates.



The whole is mounted on a wooden frame provided with levelling screws. The photograph shows the coils on the tray and the lifting device at the side.

A current of about 100 amperes is used in the straight conductor and 1–1·5 amperes in the coils.

The significance of this experiment is interesting. Neither the coils nor the magnets are small compared to the distances from the central current-carrying conductor. No precautions are taken to secure exact symmetry in the magnetization of the magnets, and the current-carrying coils themselves are not symmetrical. Although the supports of the magnets and coils are actually fixed in the apparatus as made, the position of the coils and magnets relative to one another makes no difference to the experiment. This variation of the original experiment seems, therefore, to establish the following points : (1) Any magnet, however magnetized, must be regarded as being equivalent to a system of small magnets having the properties of the ideal 'magnetic particle'. (2) A

current-carrying coil must be exactly equivalent to a system of ideal 'magnetic particles'. (3) The deductions with regard to the field of a long straight current-carrying wire as usually given.

The apparatus was constructed at the instigation of Prof. C. L. Fortescue for demonstrations to students of the Electrical Engineering Department of the Imperial College (City and Guilds College).

H. E. PARK.

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[1] See "Electricity and Magnetism", vol. 2, Art. 477.

Production of Ion Clusters by X-Rays

ACCORDING to recent work[1], X-ray-induced chromatid breaks in Tradescantia microspores are due to the simultaneous occurrence of about seventeen ionizations concentrated within the narrow section of a chromatid. Such clusters of ionizations can be produced by electrons with small kinetic energy, that is, by electrons approaching the end of their path through matter. It might be of interest, then, to determine how many clusters consisting of a given number of ionizations (n) are produced per unit volume and per roentgen; or, which is equivalent, what fraction of all ionizations is concentrated in such clusters. For the sake of simplicity, a 'cluster' will be arbitrarily assumed to consist of the last n ionizations produced by an electron at the end of its path. Accordingly, there will be as many clusters as there are electrons producing at least n ionizations along their entire path. Also for simplicity, the following calculation will be restricted to cases in which the number n is greater than 2 or 3, but is still so small that many clusters result from every photo- or Compton-electron released by X-rays.

Consider one photo- or Compton-electron A, the kinetic energy T of which is much greater than the energy, $E_n = n\varepsilon$, necessary to produce n ionizations ($\varepsilon \sim 32$ ev.). The number of secondary electrons (δ-rays) with kinetic energy between E and $E + dE$, which are in turn released by A per unit length of its path, is approximately[2] $(\pi e^4 NZ/T)(dE/E^2)$, where e is the electron charge and N the number of atoms of atomic number Z per unit volume. (It is assumed here that E is much greater than the binding energy of atomic electrons, an assumption that may not be accurately fulfilled so far as the K electrons of atoms like carbon, nitrogen, or oxygen are concerned.) The number of clusters per unit path will then be approximately:

$$(\pi e^4 NZ/T) \int_{E_n}^{\infty} dE/E^2 = (\pi e^4 NZ/T)(1/E_n).$$

Consequently, the energy contributed by the electron A per unit path to the actual production of clusters is about $\pi e^4 NZ/T$. On the other hand, the total energy lost by A per unit path is given approximately by Bloch's formula[3] $2(\pi e^4 NZ/T)log(T/B_Z)$, where the energy $B_Z = 11{\cdot}2$ ev. is an average value of the binding energy of the atomic electrons. Therefore the fraction (f) of the radiation energy actually used in producing clusters, that is, the fraction of all ionizations concentrated in clusters, will be:

$$f \sim 1/2log(T/B_Z). \qquad (1)$$

This fraction is one of the quantities characterizing the physical action of X-rays, which are approximately independent of the velocity of the photo- or Compton-electrons and hence of the X-ray wavelength. This same fraction is also independent of the number n. When formula (1) is applied to tissues of living organisms, the presence of elements with different values of Z in their chemical constitution must be taken into account. When $T = 10^5$ ev., evaluation of the formula for hydrogen and oxygen yields 1/18 and 1/14 respectively; $f \sim 1/15$ is probably a fair estimate of the result for tissue. Since 1 roentgen of X-rays produces approximately $1{\cdot}7$ ionizations per μ^3 tissue, it will also produce about $1{\cdot}7\ f/n \sim 1/10n$ clusters per μ^3.

Because of the simplifications involved in the above calculation, its results may be regarded only as an indication of order of magnitude. The purpose was mainly to present a basically simple method, which might easily be improved upon to fit the requirements of specific applications. One rough verification will be carried out here. According to Lea and Catcheside[1], the total volume of the chromatids in a *Tradescantia bracteata* microspore is $7{\cdot}6\ \mu^3$, and one chromatid break, on the average, is produced by 20 r. X-rays. Hence one break is associated, on the average, with the production of $\sim 20 \times 7{\cdot}6/10n = 15/n$ clusters in the chromatids. A one-to-one correspondence of clusters and breaks may thus be obtained by taking the value $n \sim 17$ found by Lea and Catcheside. This numerical coincidence must be regarded as partly accidental, but gives support to the conclusion that chromatid breakage requires a substantial number of ionizations occurring at a single time and place.

U. FANO.

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April 28.

[1] Lea, D. E., and Catcheside, D. G., *J. Genetics*, **44**, 216 (1942).
[2] Bohr, N., *Phil. Mag.*, **30**, 606 (1916).
[3] Bloch, F., *Z. Physik*, **81**, 363 (1933).

Relation of Hypopituitarism and Starvation

ACCORDING to an estimate recently made here, there are now about 400,000,000 people in the world suffering from malnutrition. Whatever the true figures, it is apparent that a problem of appalling dimensions exists—one which is becoming increasingly a United Nations problem, and which the collapse of the enemy would throw entirely upon our hands. Assuming the best possible management of food supplies and vitamins, one wonders whether this will be enough. One also wonders whether there may not be some overlooked weapon which can be brought to bear against hunger.

After the siege of Kut in the War of 1914–18, it took the survivors, who had been on half rations for five months, from a year and a half to two years to regain their body weight and their ability to eat normal amounts of food. This great depth and persistence of effect of chronic malnutrition can be understood, I think, only in the light of some recently acquired knowledge of the endocrines. Sir Patrick Hehir during that siege observed that sometimes emaciated but otherwise unharmed soldiers were found dead in their bunks. It is likely that they died of hypopituitary cachexia.

That malnutrition affects the endocrine organs is well known. C. M. Jackson in 1925 assembled considerable evidence that, in general, chronic inanition leads to endocrine atrophy. More recently, it has been shown that in several laboratory animals this general endocrine failure is due primarily to the inability of the anterior pituitary to send out its 'tropic' hormones. These effects of chronic malnutrition in laboratory animals have been designated as the *pseudo-hypophysectomy syndrome* by Mulinos and Pomerantz: "not only because of the resemblance between the effects of inanition and hypophysectomy but also because we believe that many of the effects of inanition are due to malnutrition of the hypophysis, resulting in a diminished secretion of hormones". The clinical analogue of this syndrome, perhaps, is found in the human disease *anorexia nervosa* (D. J. Stephens, 1941).

If this interpretation is correct (and there are many more facts to support it), then millions of people are suffering not only from starvation but also from hypopituitarism of varying degree *and kind*. Treatment of these people with hormones, supplementary to adequate diet, may well result in more rapid and complete recovery. This in turn would enable relief workers to extend their operations more rapidly, ultimately reaching more of the victims than could otherwise have been helped. Hormone treatment may be especially important for children, not only to save their lives but also to prevent stunting and dystrophic growth. Luckily, we probably should not be limited to any one hormone, since the types of endocrine failure encountered will not all be the same, and since growth and protein-economizing properties are manifested by several hormones. Synthetic hormones such as testosterone and desoxycorticosterone acetate may be found useful. Chorionic gonadotropin and sex hormones, as well as a number of pituitary extracts, have been used clinically with marked success in stimulating growth in retarded children.

At present the greatest need is for more knowledge upon the long-term effects of malnutrition, and of the period of recovery from inanition. The use of pseudo-hypophysectomized animals, some treated with hormones, can bring us much of this knowledge within a year. Cautious therapy in undernourished human beings would also be justified. The biologists and physicians of the United Nations should obtain the needed information and see that it is used.

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April 4.

Studia Moritura

THIS War has naturally set back research work in all save a few subjects. There is, however, no reason for supposing that a subject which is normally studied by a comparatively large number of people will suffer any permanent setback. Thus research on subjects such as the Vulgate text, Middle English philology or the theory of numbers will presumably again be in a flourishing state quite soon after the end of the War.

There are nevertheless a few subjects which may well be destroyed as a consequence of the War. It seems desirable that attention should be directed to such subjects now, lest even the fact that they once existed should escape notice in the future.

Finno-Ugrian philology affords an excellent example. The Finno-Ugrian group comprises four well-known languages (Finnish, Hungarian, Estonian and Lappish) and a number of lesser-known languages in the U.S.S.R. (for example, Mordvin); the Samoyede languages are distantly related. Finno-Ugrian philology has naturally always been most studied in those countries where the national language is a Finno-Ugrian one, namely, Finland, Estonia and Hungary. During the last few years before the War it was, however, only studied with real intensiveness in Finland. Finland had, in Helsinki, the Finno-Ugrian Society with its magnificent lexicographic archives of all the lesser-known Finno-Ugrian languages; these collections, going back to the beginning of the century, were for the most part still in manuscript but were in gradual course of publication. Some fifteen miles outside Helsinki, the Suomen Suku Institute, a State-sponsored research institute, had as one of its main objects the gradual compilation of a complete etymological dictionary of all the Finno-Ugrian languages. (It was hoped to complete this in about fifty years.) The University of Helsinki devoted much care to the fostering of Finno-Ugrian studies—in particular to ensuring that each of the lesser-known Finno-Ugrian languages had a specialist, and that this specialist should train a successor. There was a considerable number of young and promising students.

Estonia closely followed the model of Finland. In Tartu there were valuable Finno-Ugrian archives and the University regarded the subject as of great importance. But the smallness of the Estonian nation militated against the existence of any large body of Finno-Ugrists.

In Hungary, where we should have expected the most active interest in these studies, there was of recent years a tendency towards nationalist propaganda and anti-Semitism which on one hand lowered the standard and on the other markedly depleted the body of specialists.

The classical theory of Finno-Ugrian philology has never been a subject of study in the U.S.S.R. Nevertheless, the Russians were doing field-work of the most valuable kind—making large dictionaries and excellent grammars of all the Finno-Ugrian (and Samoyede) languages within their territories.

Outside the countries mentioned there were only isolated individuals engaged in these studies, namely, one in Uppsala, one in Oslo (both specialists of great eminence), one in Paris, one in Germany. Most unfortunately the subject was not studied in the United States, and this despite the large Finnish and Hungarian colonies there. It must be remembered that the would-be student of the subject is much handicapped by the fact that its technical literature is very largely in Finnish, Hungarian or Estonian, languages known to few non-natives.

If the classical study of Finno-Ugrian philology were to become extinct, the loss to philology as a whole would be grave. Of the many language-groups of the world only six have even the rudiments of a sound comparative philology—Indo-European, Semitic, Turkish, Indonesian, Bantu and Finno-Ugrian. Finno-Ugrian philology had made rapid advances; the phonology of the stressed syllables was almost complete; that of the unstressed syllables, the morphology and the many loan-word problems were being vigorously attacked. This group of languages offers

many points of wide philological interest; to mention only two: the existence of the most complex ablaut-system known (in Lappish) and the valuable evidence for the earliest Indo-European history afforded by the loan-words of Finno-Ugrian and Samoyede.

ALAN S. C. ROSS.

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May 15.

Illustration by Analogy

AT the recent British Association conference more attention was given to agencies (Press, B.B.C., etc.) for 'getting science across' to the ordinary citizen than to the mental technique. An outstanding technique is illustration by analogy (Jeans and Eddington in theoretical physics and the late Alfred Marshall and recently Miss Scott in economics). Instances are afforded by the likening of an atom (or electron) to a railway system, solar system and organism (de Broglie), of economic elasticity to mechanical elasticity, of economic laws to tidal law in an estuary, and of the bankers' loan and reserve system to the cyclic juggling of five oranges with both hands. Such comparisons are often effective and exact; but it is desirable that the authors, in writing, and the reader, in reading, should be clear as to what precisely is being asserted and should not fall into the intuitive trap of assuming either too much or too little.

The results of my recent work on analogy in science and language seem particularly relevant in the above connexion and possibly useful as a guide. It can be shown that all analogy is, or may be regarded as, the outcome of diverse things interacting to produce the same or similar effect or result, the result being a single property (if the *reactants*, or *analogues*, have common properties these will be connected with producing the effect); (2) analogy is the source of all substitutes and substituting. It is (2) which is especially relevant to illustration by analogy.

It will be best to take as illustrations 'analogies' somewhat simpler than those referred to above. A well-known elementary *illustrative* analogy in physics is that between a 'one-way' hydraulic system and a 'one-way' dynamo-generator current system. The operational *effect* of the two valves in the pump is identical with that of the divided ring of the commutator. A *scientific* analogy is the 'displacement' produced by the action of mechanical force on a spiral spring and of electric force on a dielectric or conductor. Another with different logical properties is the effect of strychnine on a rabbit and mercuric chloride on a man.

In all three cases we are able to illustrate the same *effect* or action by substituting one set for another. All that one does in 'popularizing' science is to choose the more familiar. It will be noted that the analogous sets or systems themselves differ in respect of substitution or rather partial substitution. The valves cannot be substituted for the commutator, but the strychnine can be substituted for the mercuric chloride at least if the maximum ultimate effect is required; so also can the rabbit and man (without interchanging the poisons).

It should be noted that logically scientific analogies, similes and parables are indistinguishable, and both may be equally true. The difference lies in the importance of the identities to the science or sciences concerned, which *partly* depends on their not being fortuitous and on their being 'exact', especially mathematically. (*Use* is the chief factor.)

When we view two analogous sets or empirical systems statically or 'structurally' we may write:

$$\lambda\,(\alpha \longrightarrow \beta)$$
$$x_1 \ldots . x_n \quad y_1 \ldots . y_n$$

(or $x_1 \rightarrow x_2 \rightarrow \ldots . x_n$, $y_1 \rightarrow y_2 \rightarrow \ldots . y_n$ if homologous series).

For the dynamic or operational view, we may write for two reactants:

$$(x_1)\ x_2 \ldots . x_n \searrow E \qquad \text{or} \qquad (x_1)\ x_2 \searrow \quad E$$
$$(y_1)\ y_2 \ldots . x_n \nearrow \equiv \lambda \qquad\qquad (y_1)\ y_2 \nearrow \equiv \lambda$$

(as in the case of simple isomorphy in the theory of groups). The differences between the x's (and between the y's) vary according to the nature of the sets or systems.

W. R. DUNLOP.

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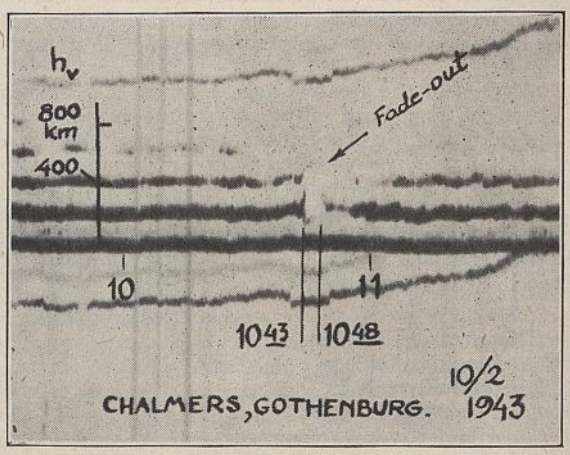
April 28.

Radio Fade-Out in Sweden

ON February 10, 1943, the Prague Observatory reported strong, brilliant sunspot eruptions. On the same day, the Chalmers Ionospheric Observatory registered a radio fade-out between 10.43 and 10.48 local time as shown by the recording. The frequency used was 2·93 Mp./s. It is interesting to note that an oblique incidence double pulse (from a distant sender) was recorded at the same time, as shown by the lowest pattern. During the fade-out, starting and ending before and after it, the recorded double



pulse was apparently reflected from the region of abnormal ionization below the regularly reflecting layer. Finally, it should be remarked that the magnetograms showed no conspicuous change at the time of the fade-out.

In order to find out whether the fade-out had any connexion with the sunspots or not, the Chalmers Observatory would like to receive observations from other observatories in the sun-lit hemisphere.

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RESEARCH ITEMS

Natives of Bolivia and Western Matto Grosso

EASTERN BOLIVIA was the mythical *tierra rica* or *eldorado* of which the Spanish explorers dreamed. Alfred Métraux has given, in 170 pages, an account of the little-known native peoples of this part of the world (Bur. Amer. Ethnol., Smithsonian Inst., Bull. 134). The various tribes are considered separately, and an account given in respect to their boundaries, history, manner of life, language, religion, etc. Anyone interested in South America and the still little-known populations of the remote interior of the sub-continent will welcome this volume, which brings together for the first time much scattered material not always very easy to consult.

Distribution and Origin of British Lepidoptera

UNDER the foregoing title, B. P. Beirne attempt to throw light on the origins and reasons for the present distribution of Lepidoptera occurring in the British Isles. This order of insects is well suited for a study of this kind because the local distribution of the majority of the species commonly known as "Macrolepidoptera" is fairly accurately known in Great Britain, in Ireland and on the Continent. In fact, their distribution is known better than that of most groups of animals. Both in Great Britain and in Ireland, Lepidoptera fall into two groups. (1) Those in which the species have a local or discontinuous range ; many of them exhibit local racial variation. (2) Those in which the species have a wide continuous distribution with little or no racial variation. It is concluded that the two groups represent two waves of immigration into the country. Species with a wide and continuous range were probably post-glacial in their time of arrival, while those with a local or discontinuous range came in during the late-glacial Zone II period and were confined in their distribution by the mountain glaciation of the Zone III period. The various points for and against this theory are discussed and the paper is published in *Proceedings of the Royal Irish Academy*, **49**, Section B, No. 2, 1943, and can be purchased separately (price 2*s*.) from Hodges, Figgis and Co., Dublin, and Williams and Norgate, London.

Role of Blue-Green Algæ in Nitre Formation in Deserts

A WORKING hypothesis that the formation of nitre in the desert may be due to the fixation of atmospheric nitrogen by bacteria of the Azotobacter type has been tested by S. V. Odintzova in the high desert of the Western Pamirs (*C.R. Acad. Sci. U.R.S.S.*, **32**, No. 8 ; 1941). Nitrate deposits were found by the author in the cracks and cavities of rocks in a zone extending between the limit of the permanent snow and approximately 4,000 m. above sea-level. Rock samples were taken under sterile conditions from the ceilings of such rock cavities and seeded upon nutrient media, in the hope of inducing the development of the bacteria if they were present, but with completely negative results. On the other hand, when rock samples were seeded upon a mineral medium of Knop and Geitler, growth of blue-green algæ was invariably obtained, *Gloeocapsa minor* being the species concerned. Tests of the ability of *G. minor* to fix atmospheric nitrogen gave positive results ; after two months of cultivation on Bortel's mineral medium deprived of nitrogen, there was a definite increase of nitrogen in the culture. When molybdenum and vanadium in Bortel's medium were replaced by calcined limestone, a considerable formation of nitrates was observed.

Sex-determination in the Wood-louse

H. W. HOWARD (*J. Genet.*, **44**, 143 ; 1943) reports further experiments on the sex-determination of *Armadillidium vulgare*. It would appear that the female is the heterozygous sex, but some females produce only males or only females, and others both males and females. It is suggested that the segregation of the *X*- and *Y*-chromosomes to the egg and polar body is not at random and may be controlled by cytoplasmic factors or by the *Y*-chromosome. The considerable data on sex-determination and transmission in natural populations are discussed.

Evolutionary Processes in Crepis

E. G. Babcock and his co-workers D. R. Cameron, J. H. Jenkins, G. L. Stebbins and others have discovered highly important facts in the genus Crepis. In a recent paper (E. G. Babcock, G. L. Stebbins and J. H. Jenkins, *Amer. Nat.*, **76**, 337 ; 1942) there is a concise statement of the more important facts relating to species relationships and origin. The genus is of distinct interest to geneticists since structural hybridity, polyploidy and gene and chromosome mutations are commonly found in the species. The authors show that gene mutations play the most important part in speciation, but that chromosome changes also initiate new forms. Secondary processes in the evolution of Crepis species are polyploidy, apomixis, and interspecific hybridization.

Control of the Club-Root Fungus

THE use of a 4 per cent calomel dust raked into the soil before sowing seeds of cabbage, radish, swede, turnip and kohl rabi was found by D. E. Green to be the most successful method of controlling club-root disease (*J. Roy. Hort. Soc.*, **68**, Pt. 4 ; April 1943). Lime, mercuric chloride and two proprietary compounds all gave considerable less control than the calomel under the conditions at the Royal Horticultural Society's Wisley garden. This result is somewhat at variance with other trials, where mercuric chloride provided the best control.

Age Determinations of Intrusive Rocks, Ontario

H. C. Horwood and N. B. Keevil have discussed (*J. Geol.*, 17 ; 1943) the age relationships of a long sequence of intrusive rocks in the Red Lake area of the district of Kenora, North-west Ontario. Field work has shown that there are ten ages of post-Timiskaming igneous activity. These the authors group into three cycles, which they call early pre-Algoman, late pre-Algoman and Algoman, respectively. Helium age-determinations have furnished corroborative data, unaltered minerals with close-packed structures and high retentivities, such as magnetite, pyroxene and hornblende, having been separated from the rocks and used as index minerals. After appropriate correction the ages of the cycles are estimated as approximately 1,760, 1,490, and 1,360 million years respectively. It is also shown that the final 'Algoman' granite is followed in turn by basic dykes, ore deposits and later basic dykes, all of which have ages of the same order. The adoption of the term 'Algoman' is unfortunate. It has been generally used in Canada for Pre-Cambrian granites of younger age than the Laurentian granites. Since

the age of the latter is well established at about 1,050 million years, while the granites and associated rocks investigated by the authors are about 300 million years *older*, it is obvious that these rocks cannot be Algoman in the accepted sense of the term. Apart from this unnecessary introduction of confusion, the authors have made a most valuable contribution to the Pre-Cambrian geology of Ontario.

A New Synthesis of Pyridine

THE reaction of glutarimide with phosphorus pentachloride was studied by Bernheimer in 1882 and he reported that a crystalline compound was formed, to which he assigned a formula. W. W. Crouch and H. L. Lochte (*J. Amer. Chem. Soc.*, **65**, 270 ; 1943) have now shown that the compound is a trichloropyridine, 2,3,6-trichloropyridine, not previously identified. This was hydrogenated to pyridine. Similar reactions with methyl and dimethyl glutarimides yielded the corresponding pyridine homologues, 2,5,6-trichloro-3-picoline and 2,6-dichloro-3,5-lutidine.

Electrolytic Oxidation of Formaldehyde

THE electrolytic oxidation of formaldehyde in acid, neutral, and alkaline solutions, with a variety of anodes, has been investigated over a wide range of current densities by A. Hickling and F. Rodwell (*J. Chem. Soc.*, 90 ; 1943). The results show a complex dependence on the experimental conditions, but three main sets of oxidation products were distinguished : (1) formic acid and hydrogen, (2) formic acid and water, and (3) carbon dioxide and water. The results are explained by the assumption that the primary oxidation is due to hydrogen peroxide formed at the anode, nascent oxygen and oxides formed with the electrode materials playing supplementary parts. The hydrogen peroxide may oxidize formaldehyde to $CH_2(OH).O.O.CH_2.OH$, which in alkaline solution decomposes into $2H.CO_2H$ and H_2, and in acid or neutral solution into $H_2O + H.CO_2H + H.COH$. The peroxide may also form water and nascent oxygen (which may be partly evolved as gaseous oxygen. The nascent oxygen may oxidize formaldehyde to formic acid and this to carbon dioxide and water, or it may form with the anode a metallic oxide which in acid or neutral solution has very little action but in alkaline solution may oxidize formaldehyde to formic acid, and/or hydrogen and formic acid.

Specific Heats of Hydrocarbons

THE question of the hindered rotation of molecules such as ethane, $H_3C.CH_3$, in which the two groups joined by a single bond encounter potential barriers as atoms or groups on the rotating parts come near one another, has been studied from the side of the specific heats, from which the existence of a sinusoidal hindering potential has been confirmed. In the case of ethane this is approximately 3,000 gm. cal. The experimental results are not always in good agreement, and B. P. Dailey and W. A. Felsing (*J. Amer. Chem. Soc.*, **65**, 42, 44 ; 1943) have redetermined the values for ethane, propane, *n*-butane and *iso*-butane over the temperature range of about 340–700° K., using an adiabatic flow type calorimeter. The agreement between the experimental and calculated values in the cases of ethane and propane is within the limit of experimental error (1 per cent). The specific heat of *n*-butane was slightly higher than that of *iso*-butane, and the results at lower temperatures were in agreement with theory within the limits of experimental error. At higher temperatures deviations are found. In another paper, J. F. Lemons and W. A. Felsing (*ibid.*, 46) give some determinations of the latent heats of evaporation of *n*-hexane, 2-methyl-pentane and 2,3-dimethyl-butane, and find that the latent heat is smaller the greater the branching of the chain.

Demonstrations of Base Exchange

USE of the ordinary bath sponge as a model for demonstration of ionic exchange phenomena has been described by S. Mattson (*Lantbrukshögskolans Ann.*, **10**, 56–73 ; 1942). Demonstrations of simple exchange (calcium and ammonium) and of the valence effect are thereby made easy. One experiment with sponge, using sodium and alkaline-earth salts in conjunction with methylene blue, also shows the lyotropic effect. Methylene blue is very suitable for demonstrating the laws of ionic exchange, as its activity in combination with the sponge acidoid is great enough to allow a considerable displacement of the common cations. Effects of hydrolysis are readily shown, and by inference the formation of soda when a saline soil is leached : the 'classical' theory relating to this is called "one of the most bungled in soil science". Mattson points out the need for making students familiar with the fundamental relationships of ionic exchange. "There is no such thing as a definite exchange capacity of a soil. The capacity to bind base and exchange metal cations varies greatly with the nature and concentration of the ions in solution". The points made would probably have interest for physical and inorganic chemists, especially since Mattson shows how to demonstrate the ability of a silver chloride precipitate to bind and exchange cations. The exchange capacity of "the simple, 'stoichiometric' compound we think of as AgCl" is as great as that of many a sandy soil.

Obscuration around the North Pole

E. G. MARTIN gave an account of an examination of counts of stars in the Greenwich Astrographic Zone (*Mon. Not. Roy. Astro. Soc.*, **102**, 5 ; 1942), a summary of which appeared in NATURE of January 2, p. 27. As these counts were not compiled for the region within 3° of the north pole of the sky, and as it is now fairly certain that there is obscuration in this area, Martin has examined this region (*Mon. Not. Roy. Astro. Soc.*, **102**, 6 ; 1942). The Greenwich counts show that stars of mag. 8 are not obscured and that absorption at a distance of 200 parsecs is unlikely. Other sources were examined in which colour excesses and spectroscopic distances were used with the object of detecting reddening. Seares has given −0·14 mag. as the mean colour index for unobserved *A*0 stars—a figure which has been used to correct the zero of the Harvard photovisual magnitudes—and Martin has examined the *A*0 stars to see if they confirm this figure. He finds that the mean result is −0·07 mag., and, while admitting from other evidence that this may be slightly small numerically, he considers that −0·14 mag. is numerically too large and that its adoption has exaggerated the reddening near the north pole of the sky. There is therefore little evidence of reddening at 200 parsecs affecting stars of mag. 8, and it is suggested that a more reasonable distance is 500–600 parsecs where *A*-type stars of mag. 9·0 or 10·0 are affected. Further research is advocated, but with a number of modifications and precautions in deriving the colour index of *A*0 stars.

VITAMINS OF THE B-GROUP REQUIRED BY INSECTS

By DR. G. FRAENKEL and M. BLEWETT
Imperial College of Science and Technology, London

SINCE our last communication on this subject[1], we have grown five different insect species, *Tribolium confusum*, *Ptinus tectus*, *Sitodrepa panicea*, *Lasioderma serricorne* and *Silvanus surinamensis*, on an artificial diet, consisting of casein 50, glucose 50, cholesterol 1, insoluble part of yeast 5, McCollum's salt mixture 2, water 15, and wheat germ oil 7 mgm./gm. The following vitamins of the B-group were added in pure substance: B_1, riboflavin, nicotinic acid, B_6, pantothenic acid and *p*-amino-benzoic acid (50 μgm./gm. of the dry diet), choline chloride and *i*-inositol (500 μgm./gm.). In a number of parallel tests the vitamins were left out one at a time. The results obtained with Ptinus and Lasioderma are given in Figs. 1 and 2, and all the results are summarized in the accompanying table.

The same series of tests was also carried out with Tribolium on a diet which contained biotin (appr. 0·1 μgm./gm.) instead of insoluble yeast (Fig. 3).

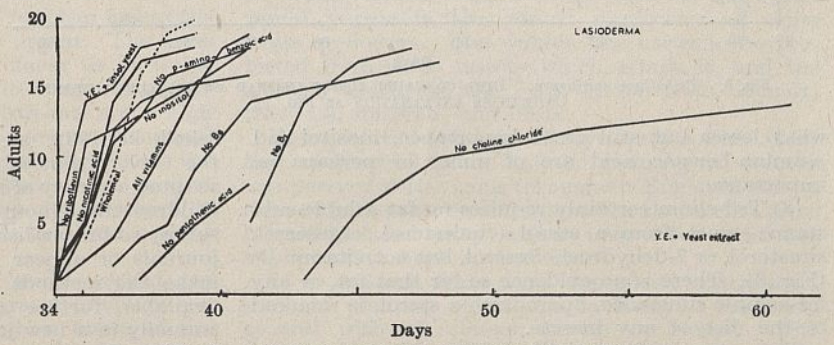

Fig. 2. *Lasioderma serricorne*. EXPLANATION AS FIG. 1.

GROWTH OF FIVE SPECIES OF INSECTS ON DIETS CONTAINING ALL THE CHEMICALLY KNOWN FACTORS OF THE VITAMIN B COMPLEX IN PURE SUBSTANCE (WHOLE DIET) AND ON DIETS WHICH WERE LACKING IN ONE SINGLE B-FACTOR.

	Tribolium	Ptinus	Silvanus	Lasioderma	Sitodrepa
Control: containing yeast extract	++++	+++(+)	++++	++++	++++
Whole diet	++++	++++	++++	++++	++
No B_1	+	±	++++	+++	—
No riboflavin	±	—	++	++++	+(+)
No nicotinic acid	—	—	±	++++	++
No B_6	++	+	+++(+)	+++	+(+)
No pantothenic acid	+	±	±	++	+
No choline chloride	+++	++	+++(+)	+(+)	++
No *i*-inositol	+++	+++	+++(+)	++++	++
No *p*-amino-benzoic acid	+++(+)	+++	+++(+)	++++	++

From these tests, and others, the following conclusions can be drawn concerning the vitamin requirements of insects:

(1) Ptinus and Tribolium require the five major components of the B-complex, B_1, riboflavin, nicotinic acid, B_6 and pantothenic acid as essential growth factors. Silvanus requires only riboflavin, nicotinic acid and pantothenic acid; Sitodrepa, B_1 and pantothenic acid, and Lasioderma apparently none of them. The difference of vitamin requirements of these five insects is, possibly, due to the presence in Sitodrepa, Lasioderma and Silvanus, but not in Tribolium and Ptinus, of intracellular symbiotic micro-organisms, which may supply vitamins.

(2) Choline chloride is an essential food factor for at least two of the insects, Ptinus and Lasioderma, and probably of some importance for Tribolium too.

(3) Inositol and *p*-amino benzoic acid may be of some slight value for Tribolium and Ptinus.

(4) A diet which contains the eight pure factors of the vitamin B-complex, and no source of undetermined water-soluble B-vitamins, is in every respect as good as the control diet, which contains yeast extract, or as wholemeal flour (only exception Sitodrepa). Insects therefore do not seem to require any unidentified vitamins of the B-group.

(5) The only substance which Tribolium requires from insoluble yeast is biotin, provided the diet contains a sterol. With the eight soluble B-factors and biotin supplied in pure substance no further addition of known or unknown vitamins is necessary.

(6) The optimal requirements of biotin for Tribolium are 0·1 μgm./gm. of the dry diet and the threshold of action is between 0·006 and 0·003 μgm./gm.

(7) There are very striking analogies in the requirements of vertebrates and insects of the nine chemically known factors of the vitamin B complex. For both groups, B_1, riboflavin, nicotinic acid, B_6 and pantothenic acid are indispensable, choline and biotin are of some-

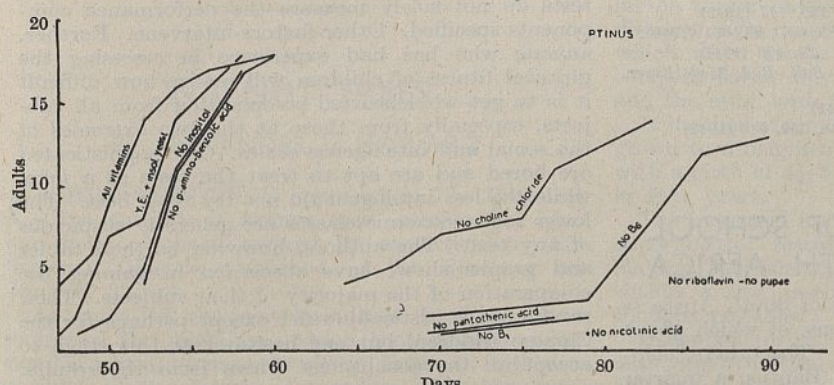

Fig. 1. GROWTH OF *Ptinus tectus* ON DIETS CONSISTING OF CASEIN, GLUCOSE, INSOLUBLE YEAST, CHOLESTEROL, SALTS, WATER AND 8 MEMBERS OF THE VITAMIN B-COMPLEX, COMPARED WITH SIMILAR DIETS FROM WHICH SINGLE VITAMINS HAVE BEEN LEFT OUT ONE AT A TIME.

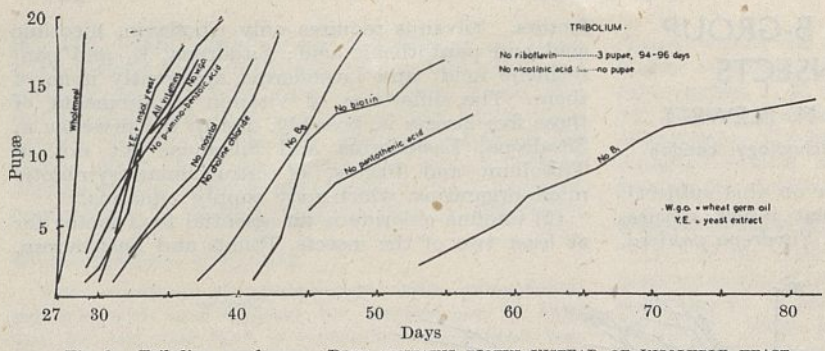

Fig. 3. *Tribolium confusum*. DIET CONTAINS BIOTIN INSTEAD OF INSOLUBLE YEAST. OTHERWISE EXPLANATION AS FIG. 1.

what lesser but still great importance, inositol and *p*-amino-benzoic acid are of minor or perhaps no importance.

(8) Tribolium certainly requires no fat-soluble substance apart from a sterol (cholesterol, ergosterol, sitosterol, or 7-dehydrocholesterol, but not vitamin D) (Fig. 3). There is no evidence so far that fat, or any fat-soluble substance, apart from a sterol, is required in the diet of any insects.

These results essentially agree with and extend recent findings of other authors concerning vitamin requirements of insects. Subbarow and Trager[2] demonstrated the need of the mosquito larva for B_1, riboflavin, B_6 and pantothenic acid, and Tatum[3] demonstrated that the Drosophila larva, in addition to B_1 and riboflavin, also required B_6, nicotinic acid and pantothenic acid. Galleria requires nicotinic acid[4]. In none of these cases did the insects grow satisfactorily without the further addition of yeast or yeast fractions. Barton-Wright's[5] failure to grow Tribolium satisfactorily on artificial diets must have been due to absence of pantothenic acid, choline and perhaps other minor factors from his diet, which may also have been very low in biotin. In sharp contrast to our findings, and those of others, are the recent claims of Rosenthal and Reichstein[6], according to which B_1, nicotinic acid and biotin are the only B-factors required by Tribolium. These differences of results are, in our view, due rather to the use of insufficiently purified ingredients in the diet of these authors than to differences in the insect stocks or to contamination of diets by micro-organisms.

We gratefully acknowledge a Government grant, made by the Royal Society, which, partly, made this investigation possible.

[1] Fraenkel, G., and Blewett, M., NATURE, **150**, 177 (1942).
[2] Subbarow, Y., and Trager, W., *J. Gen. Physiol.*, **23**, 561 (1940).
[3] Tatum, E. L., *Proc. U.S. Nat. Acad. Sci.*, **27**, 193 (1941).
[4] Rubinshtein, D. L., and Shekun, L. A., *Bull. Biol. Med. Exper.* (1941).
[5] Barton-Wright, E., NATURE, **148**, 565 (1941).
[6] Rosenthal, H., and Reichstein, T., NATURE, **150**, 546 (1942).

PHYSICAL FITNESS OF SCHOOL CHILDREN IN SOUTH AFRICA

THE population of the Union of South Africa is slightly more than ten millions, of which about one fifth are of European stock. The others, comprising seven million aboriginal Bantus, a quarter of a million Asiatics (Indians and Chinese) and about a million 'coloureds' (that is, Eurafricans and Eurasians) on the whole exist at a lower socio-economic level than the bulk of the white population. Nearly a fifth of the Europeans fall into the category of 'poor whites'—people who, from one cause or another, have lost their sense of responsibility. In fact, they are below the aboriginal race in physique and in general nutritional level. The 'poor white' problem in the Union was investigated in 1929, by Murray, for the Carnegie Commission, and his report, published in 1932, so shocked the *amour propre* of the Government of the Union that, in 1937, it instituted a survey of the state of nutrition of the school children throughout the Union. The results of this survey so far published are scattered through various journals or appear in special reports. In order to make the methods and results of the survey more available, further studies are to be published biannually in a new journal called *Manpower*, the first number of which has recently reached Great Britain*. It contains, besides a very thoughtful and thought-provoking editorial, two original papers by E. H. Cluver, E. Jokl and T. W. de Jongh—authors already well known for their researches on nutrition in the Union and for a monumental work on the results of a rehabilitation service for young men.

The first of these articles, on "A National Manpower Survey of South Africa", deals with "The Principle of Physical Performance Grids" while, in the second article, a comparison is made between the physical efficiency standards of Bantu, Chinese 'Coloured', European and Indian children by the use of these 'grids'. In order to "arrive at a basic system of co-ordinates which can serve as an objective interpreter of any subsequent results of individual or group tests which may be conducted with samples of school children of all ages between 6 and 18 years, tests had to be selected which were purely objective, which could be applied simply and universally and which would give information of distinct physiological significance". The three performance components, skill, endurance and strength, were estimated by the time taken to run 100 yards and 600 yards, and the distance over which a 12 lb. shot could be thrown respectively.

Fault could be found with this choice in that the tests do not solely measure the performance components specified. Other factors intervene. Further, anyone who has had experience in assessing the physical fitness of children will realize how difficult it is to get wholehearted co-operation from all subjects, especially from those at the two extremes of the social and intelligence scales. The sophisticated are bored and are apt to treat the tests as a joke, while the less intelligent do not try their best. The lower socio-economic classes are generally suspicious of any test. The authors, however, as their tables and graphs show, have succeeded in gaining the co-operation of the majority of their subjects. Their results are statistically valid except perhaps for the Chinese children, but one hesitates at this stage to accept all the conclusions drawn from the results.

* *Manpower* (*Volkskragte*): a Biannual Scientific Journal, Vol. 1, No. 1. Issued by the National Advisory Council for Physical Education, Pretoria. 7*s*.

The authors themselves feel this and state, "We are clearly aware of the elementary nature of our experimental material. The present evidence will have to be extensively supplemented before it can be expected to act as a scientific guide to the physical education profession".

The attempt to carry out large-scale tests of skill, endurance and strength is courageous, and further papers are promised from this source in which these tests will be correlated with somatometric and other measurements. The difficulties of any wholesale methods are appreciated, but the problem facing the health services in South Africa is urgent. The same problem with the same urgency faces us in Great Britain. We have our 'poor whites' and they, like those of the Union, have a high birth-rate and a high infant death-rate, but because they are not compared with a black indigenous race, it is difficult to make the ordinary citizen aware of the difficulties and dangers to the nation of this submerged tenth which, if it maintains its present fertility, will be about a third of the next generation.

The second paper applies the 'grids' worked out in the first paper to the various races found in the Union. The authors do not say how many of the Europeans tested fell into the 'poor white' category, but they certainly weight the result. "In spite of the generally known deficiencies in their environment, in spite of their poor housing conditions, in spite of their bad food, in spite of the manifest insufficiencies of their health services and their education, the Bantu's physical abilities are superior to those of the European's". This superiority is consistent in the girls but variable in the boys. From 12·5 years to 18 the European boy is the equal and generally the superior of the Bantu in the 100 yards and 600 yards race, while at all ages he shows greater strength (putting 12 lb. shot).

From a third article, by P. J. Kloppers, entitled "Personality, Disease and the Social System", we cull the following significant sentence. "It may in truth be said that it is more important to know what kind of a man has a disease than what kind of a disease a man has".

The remaining sixteen pages are devoted to an illustrated review of the literature of man-power studies, both current and classical, ranging from "Animated Statistics", taken from Neurath's "Modern Man in the Making", to reproductions of postage stamps which picture various sports.

D. BURNS.

WALNUT TREES

By ALEXANDER L. HOWARD

CORRESPONDENCE appeared in *The Times* on the subject of walnut trees some years ago, and has now been revived by an article by Sir Stephen Tallents, published in the *Spectator* on January 22.

As some of the correspondents in *The Times* expressed the mistaken opinion that walnuts could not be grown advantageously in England, and also as the majority of trees of any size or quality have been felled in the course of the last twenty years for commercial use of the wood, it would seem desirable to direct attention to the importance of replanting.

This should be carried out in the interests both of the fruit and the timber. Through ignorance and want of care, perhaps the largest number of those who possess trees have failed to reap a harvest of good walnuts during the last fifty years, but that it is possible to produce equally good quality throughout England and Wales with that provided in Europe is without doubt. To secure a crop of nuts the same attention should be paid to the trees as the owner would pursue in the annual production of other fruits or flowers. The walnut tree needs to be protected from those insects which attack it, and the animals which eat the fruit on the trees, namely, tree rats, squirrels, and birds.

From the time of John Evelyn until a little more than a hundred years ago the planting of walnuts was pursued with vigour throughout England, but by degrees both practice and interest in the subject have insensibly faded away, and in only a few cases has any planting been carried out.

It is evident from very superficial observation that the planting of walnuts in Evelyn's time was general with all classes, poorer or richer. The traveller throughout Kent, by way of Sussex, through Hampshire, Dorset, and down to Somerset and Devonshire, will continue to find walnut trees adorning not only the greater or manor houses, but also villages and the gardens of country cottages.

Unfortunately, during the last fifty years all the larger trees have been eagerly sought for, and however reluctantly, eventually sold to the dealer, who has discovered the great value which the wood possesses. No other timber tree has been in such regular demand, or consistently brought the owners such a high reward during the last century.

John Evelyn's praise of the Virginian black walnut (*Juglans nigra*) has often been quoted. This tree is perhaps in its maturity more attractive than the European (*Juglans regia*), and therefore found favour with Evelyn, who probably did not live long enough to find the disadvantages of attempting to establish it in England, where it is difficult to rear in large numbers. Individual splendid specimens could be found, many of which are noted in Elwes and Henry's "Trees of Great Britain and Ireland"; but inquiry will reveal that they are isolated specimens which, on account of their protected positions, have prospered. The tree grows rapidly in its early life, but does not thrive in the cold damp climate of Great Britain, often failing to harden off its autumn growth in the winter unless in a protected position. These disadvantages do not apply to the European variety, which when grown in England and cared for will compete favourably, both in regard to the timber and the nuts, with the American variety.

It has been found possible to rear trees which had grown to a height of 5–8 ft., and occasionally more, with a girth of 4½–5 in. at two feet from the ground, in four years.

The increased knowledge which has resulted from experimental research work carried out at East Malling has shown that a crop can be expected within a less period of time than was formerly thought possible.

In her generosity Nature has provided us in England with opportunities for the provision of useful fruit and valuable timber: it should be our pleasure and indeed duty to take the fullest possible advantage of these opportunities which she offers.

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

Saturday, June 19

INSTITUTE OF PHYSICS (JOINT MEETING OF THE ELECTRONICS GROUP AND THE MANCHESTER AND DISTRICT BRANCH) (in the Physics Department, The University, Oxford Road, Manchester), at 2.30 p.m.—"The Electrical Discharge in Gases" (Dr. T. E. Allibone will speak on "Discharge Phenomena" and Dr. J. M. Meek on "Modern Theories of the Discharge").

Monday, June 21

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Annual General Meeting.

Wednesday, June 23

ROYAL METEOROLOGICAL SOCIETY (at 49 Cromwell Road, South Kensington, London, S.W.7), at 4.30 p.m.—Discussion on "The Applications of Meteorology to Industry" (to be opened by Mr. J. F. Shipley).

Thursday, June 24

TOWN AND COUNTRY PLANNING ASSOCIATION (at 1 Grosvenor Place, London, S.W.1), at 1.15 p.m.—Prof. Ernest Barker: "Social Background of Town Planning".

Thursday, June 24—Friday, June 25

BRITISH COAL UTILIZATION RESEARCH ASSOCIATION (at the Royal Institution, 21 Albemarle Street, London, W.1)—Conference on "The Ultra-fine Structure of Coals and Cokes, with special reference to the Application of Modern Physical Methods".*

APPOINTMENTS VACANT

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

MILK ADVISORY OFFICER (FEMALE) to the Holland War Agricultural Executive Committee—The Principal and Executive Officer, Agricultural Institute, Kirton, Boston, Lincs. (June 23).

SECOND SPEECH THERAPIST at the Child Guidance Clinic—The Education Officer, The Guildhall, Cambridge (June 25).

HEAD OF THE ENGINEERING DEPARTMENT in the South-East Essex Technical College and School of Art, Dagenham—The Chief Education Officer, County Offices, Chelmsford (June 25).

PSYCHIATRIC SOCIAL WORKER (TEMPORARY) to work with the Psychiatrist and Psychologist in the Child Guidance Clinic—The Town Clerk, Town Clerk's Office, Town Hall, Reigate (endorsed 'Psychiatric Social Worker') (June 25).

ASSISTANT MASTER (TEMPORARY) mainly to teach Physics in the Handsworth Junior Technical School—The Chief Education Officer, Higher Education Department, Education Office, Council House, Margaret Street, Birmingham 3 (June 25).

ASSISTANT (MAN) in Junior Technical School and part-time Day Classes of Redditch Technical School for Mathematics, Mechanics, Engineering Drawing, Workshop Technology and Elementary General Science—The Director of Education, County Education Offices, County Buildings, Worcester (June 26).

DIRECTOR OF THE TRANSVAAL MUSEUM, Pretoria—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, London, W.C.2 (June 26).

LECTURERS (two) IN BUILDING SUBJECTS in the Hull Technical College—The Director of Education, Guildhall, Hull (June 26).

LECTURER IN BIOLOGY AND HYGIENE, with GENERAL SCIENCE—The Principal, Kenton Lodge Training College, Newcastle-upon-Tyne (June 26).

MISTRESS TO TEACH GEOGRAPHY AND BOTANY in the Nottinghamshire Rural Pupil-Teacher Centres—The Director of Education, Shire Hall, Nottingham (June 26).

TEACHER (MAN) OF MATHEMATICS AND ENGLISH in the new Building Trades Junior Technical School at the Hull Technical College—The Director of Education, Guildhall, Hull (June 26).

HEAD OF THE SCIENCE DEPARTMENT, and a TEACHER OF GENERAL SCIENCE SUBJECTS, in Acton Technical College—The Secretary (T), Middlesex Education Committee, 10 Great George Street, Westminster, London, S.W.1 (June 26).

TEACHER OF BUILDING SUBJECTS in the Junior Technical School and the Technical College, and a TEACHER OF MINING SUBJECTS (applicants should have industrial and teaching experience and be prepared to teach Mine Surveying), in the Whitwood Mining and Technical College—The Director, Education Offices, Castleford, Yorks (June 26).

SPEECH THERAPIST—The Education Officer, Education Offices, Northern Secondary School, Mayfield Road, Portsmouth (June 28).

PSYCHIATRIC WORKER (TEMPORARY)—The Chief Education Officer, County Hall, Taunton (June 30).

LECTURER IN ANIMAL HUSBANDRY at the Imperial College of Tropical Agriculture in Trinidad—The Acting Secretary, Imperial College of Tropical Agriculture, Grand Buildings, Trafalgar Square, London, W.C.2 (June 30).

TEACHER OF PRODUCTION ENGINEERING—The Principal, Dolcoath Technical School, Camborne, Cornwall (July 1).

ASSISTANT ENGINEERS (4) IN THE DEPARTMENT OF POSTS AND TELEGRAPHS—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (July 2).

WOMAN PSYCHIATRIC SOCIAL WORKER—The Director, School Clinic, 7 Leopold Street, Sheffield (July 3).

ASSISTANT ENGINEER for the Government of Dominica (should be qualified civil engineer with extensive experience of road construction)—The Secretary, Overseas Manpower Committee (Ref. 904), Ministry of Labour and National Service, Sardinia Street, Kingsway, London, W.C.2.

LECTURER IN GEOGRAPHY—The Secretary, Homerton College, Cambridge.

MASTER FOR CHEMISTRY, and a MASTER FOR BUILDING SUBJECTS—The Principal, County Secondary School and Cumberland Technical College, Workington.

DOMESTIC SCIENCE ASSISTANT preferably with Degree in Social Science, in the Day Technical School for Girls, and an ASSISTANT FOR MATHEMATICS, ENGINEERING SCIENCE, MACHINE DRAWING, in the Day Technical School for Boys—The Principal, Technical Institute, Longport Street, Canterbury.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Scientific Proceedings of the Royal Dublin Society. Vol. 23 (N.S.), No. 9: Salmon and Sea Trout of the Waterville (Currane) River. By Arthur E. J. Went and T. Sankey Barker. Pp. 83–102. 2*s*. 6*d*. Vol. 23 (N.S.), No. 10: Ascorbic Acid, Part 1: Detection and Estimation. By W. R. Fearon and Einhart Kawerau. Pp. 103–110. 1*s*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [115

Ollsgoil na h-Éireann: The National University of Ireland. Calendar for the Year 1942. Pp. x+614. (Dublin: National University of Ireland.) [115

Metallurgical Abstracts (General and Non-Ferrous). Vol. 9, 1942 (New Series). Edited by N. B. Vaughan. Pp. viii+440. (London: Institute of Metals.) [115

The Journal of the Institute of Metals. Vol. 68, 1942. Edited by N. B. Vaughan. Pp. xxxii+430+37 plates. (London: Institute of Metals.) [115

Public Museums, Gloucester. Occasional Papers, No. 5: *Glevum* and the Second Legion. By Charles Green. Part 1. Pp. 14. (Gloucester: Public Museums.) 6*d*. [125

Department of Scientific and Industrial Research: Forest Products Research. Recognition of Decay and Insect Damage in Timbers for Aircraft and other Purposes. Pp. iv+18+4 plates. (London: H.M. Stationery Office.) 6*d*. net. [125

Planning of Science. Report of Proceedings of the Open Conference held at Caxton Hall, January 30th–31st, 1943. Pp. 127+8 plates. (London: Association of Scientific Workers.) [145

Proceedings of the Royal Irish Academy. Vol. 49, Section A, No. 1: On the Particle Equation of the Meson. By W. Heitler. Pp. 28. 1*s*. 6*d*. Vol. 49, Section A, No. 2: Systematics of Meson-Matrices. By E. Schrödinger. Pp. 29–42. 1*s*. Vol. 48, Section B, No. 12: Salmon of the River Corrib, together with Notes on the Growth of Brown Trout in the Corrib System. By Arthur E. J. Went. Pp. 269–298+plate 2. 2*s*. Vol. 49, Section B, No. 1: The Solubility of Soil Constituents in Oxalic Acid as an Index to the Effects of Weathering. By Patrick H. Gallagher and Thomas Walsh. Pp. 26+1 plate. 1*s*. 6*d*. Vol. 49, Section B, No. 2: The Distribution and Origin of the British Lepidoptera. By Bryan P. Beirne. Pp. 27–60. 2*s*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [175

Other Countries

Ceylon. Part 2 (Revenue I). Administration Report of the Government Mineralogist for 1941. By D. N. Wadia. Pp. I.10. (Colombo: Government Record Office.) 20 cents. [115

Imperial College of Tropical Agriculture. Report of the Governing Body and the Principal's Report to December 31st, 1942. Pp. 24. (Trinidad and London: Imperial College of Tropical Agriculture.) [115

Memoirs of the American Philosophical Society. Vol. 17: John Brown and the Legend of Fifty-Six. By Prof. James C. Malin. Pp. xii+794. (Philadelphia: American Philosophical Society.) [115

Proceedings of the United States National Museum. Vol. 92, No. 3154: Revision of the Genus *Phloeosinus* Chapuis in North America (Coleoptera, Scolytidae). By M. W. Blackman. Pp. 397–474+plates 38–41. Vol. 93, No. 3159: Some American Geometrid Moths of the Subfamily Ennominae heretofore associated with or closely related to *Ellopia* Treitschke. By Hahn W. Capps. Pp. 115–152+10 plates. (Washington, D.C.: Government Printing Office.) [135

Bulletin of the Bingham Oceanographic Collection, Peabody Museum of Natural History. Vol. 8, Art. 2: A Review of the American Anchovies (family Engraulidae). By Samuel F. Hildebrand. Pp. 165. (New Haven, Conn.: Yale University.) 2.50 dollars. [135

Indian Forest Records (New Series). Utilisation, Vol. 2, No. 11: A Note on the Maintenance of Plywood in India. Compiled by Dr. S. N. Kapen. Pp. vi+245–292. (Delhi: Manager of Publications.) 1·2 rupees; 1*s*. 9*d*. [175

Indian Forest Leaflet No. 35: Charcoal for Producer-Gas Plant. By S. Ramaswami, A. C. Dey and B. S. Varma. Pp. ii+6. (Dehra Dun: Forest Research Institute.) 4 annas: 6*d*. [175

Bulletin of the Bingham Oceanographic Collection, Peabody Museum of Natural History. Vol. 8, Art. 3: The Eggs of *Bathygobius soporator* (Cuvier and Valenciennes) with a Discussion of other Non-spherical Teleost Eggs. By C. M. Breder, Jr. Pp. 50+6 plates. (New Haven, Conn.: Yale University.) [175

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