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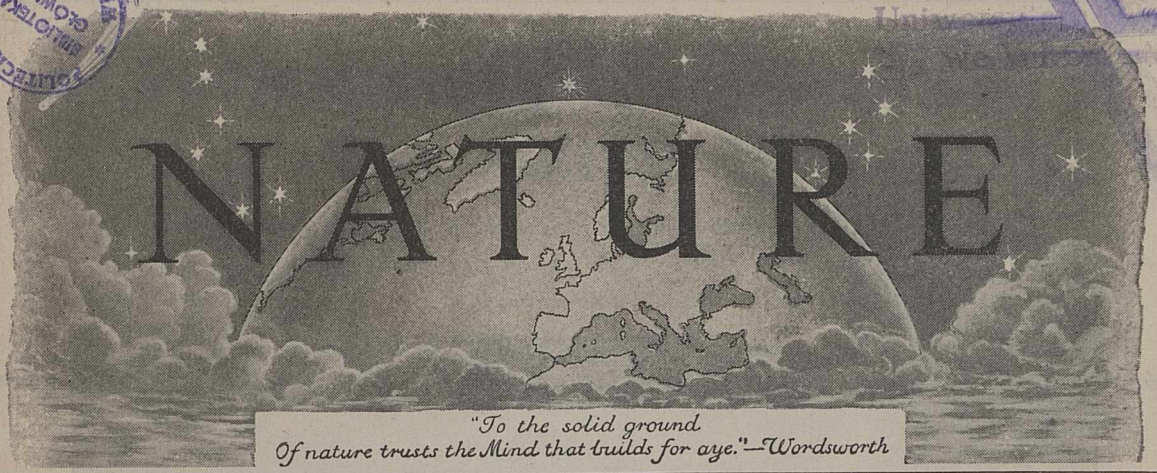

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NATURE

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CONTENTS

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LOCATION OF INDUSTRY AND PROVISION OF MAN-POWER

THE memorandum, "Considerations Affecting Post-War Employment in the North-East", which has been issued by the Northern Industrial Group, consisting of employers and trade-union leaders in northern England, and which has been sent to the Minister of Reconstruction, is not only of interest in relation to post-war reconstruction and employment policy and the change from a war to a peace economy. It may well be compared with the report submitted in May 1935 to the District Commissioner for Depressed Areas by a joint committee of the local sections of the Society of Chemical Industry, the Royal Institute of Chemistry and the Chemical Society, and with a subsequent report, "The Industrial Position of the North-East Coast of England", issued later in the same year by the staff of the Economics Department of Armstrong College, Newcastle on Tyne. The conclusions reached in the latter report appear to be fully confirmed and to be as valid to-day as eight years ago, and substantially the same is true of the other report and especially of the section contributed by the sub-committee on science and industry.

The Northern Industrial Group in its memorandum points out that the War has brought no real change to the industrial structure in the area. That structure remains much as it was in the days of the depression ; and unless adequate preventive measures are taken there is real danger that the employment and standard of living of people in the area will again be seriously threatened after the present War. Still more disturbing, not to say disappointing, is the absence in this memorandum of any real evidence that the lessons set forth so clearly in the reports from Armstrong College and the joint committee of the chemical societies have been learnt, or of the extensive application of scientific methods to those industries which situation and local raw materials make possible. Something more than vigorous action on the part of the central Government still appears to be required to eliminate the threat of large-scale unemployment in the area ; and while responsibility for the position cannot fairly be laid entirely on the industrial leaders of the area, they have yet to clear themselves of the charge of absence of foresight and neglect of science brought against them eight years ago.

There are other respects in which the general situation has changed ; but the indictment in the earlier reports needs to be kept in mind the more because of the shift in emphasis from local to national responsibility, which has been accentuated in the interval. It is now widely recognized, and rightly, that certain basic decisions as to policy must be made by the central Government before local authorities or even regional authorities can act wisely or effectively. The memorandum of the Northern Industrial Group assumes first, for example, that a national economic policy will be adopted, and that to secure ample employment in reparation and reconstruction work at home and abroad the Government

will continue to control production in some way for an interim period of unknown length after the War, with a gradual change to a peace-time economy. In this interim period, any deficiencies in employment in Great Britain should be met by work on the many necessary schemes for public works. National policy should also assure a stable level of employment in the heavy industries and in agriculture.

Even with such measures, on the basis of the immediate pre-war industrial structure of the region, there will be a surplus of some 130,000 persons for whom employment will have to be found, and such estimates of the post-war capacity of the heavy industries in the area as the Group is able to make suggest that new forms of occupation will be required for more than 100,000 people, even without allowing for women seeking employment. The Group, however, firmly rejects the large-scale transfer of population from the north-east of England to other areas as socially and economically undesirable; although there is nothing in the memorandum to indicate dissent from the view implicit in the Beveridge Report that greater mobility of labour generally is desirable, if not essential. The memorandum holds that the future policy should be to employ people in their own surroundings. The Group believes that the north-east of England has its own background and a tradition of virility and of independence which is an asset to the nation and should be preserved. Social security may, in fact, increasingly necessitate the adjustment of employment to the distribution of population.

Such considerations lead to the conclusion that the solution of the industrial problem of the north-east of England lies in the development in the area of a much greater variety of industries making highly developed products suitable for export as well as for the home market. Such a development would mitigate a permanent change in employment by heavy industry and provide a reserve of employment to meet fluctuations. In particular, further developments in the area of the processing of coal to oil, plastics, etc., are recommended, and the memorandum urges that whatever emerges as part of Great Britain's fuel policy from experimental work now in progress should be concentrated in this and other coal-producing regions. Again, certain parts of the area should be cleared of derelict buildings to encourage development, and any further capacity required for war production should be located in the area. After the War, an active policy of building factories in the area to make up for the effects of war development should be prosecuted, with the transfer of factories rather than labour.

All this, and the continuance of the measures adopted before the War to bring light industries to the north-east of England, involves a national policy for the location of industry, and the memorandum once more directs attention to the necessity for implementing the recommendations of the Barlow Commission. The reference to this question which Lord Woolton made in his recent statement shows that the Government is already giving some attention to the problem of structural unemployment, and Lord Woolton suggested that the Government might use the disposition of State factories to assist the creation of a diversity of industries in areas such as the north-east coast. Mr. Dalton had already broached the idea that such factories might become the nucleus of new trading estates, and it may be that the Government is giving more attention to the location of industry than has appeared in its pronouncements.

Other recommendations in this memorandum touching on the same question are the consideration of freight rates and their effect on the location of new industries, the provision of national finance for the local reorganization of housing and industry in certain areas such as part of south-west Durham, amendment of housing legislation to allow of more flexibility and a closer co-ordination with industrial policy and the provision of additional trading estate facilities in the area. Once again the multiplicity of local authorities, particularly on Tyneside, and the limitations of the rating system, with the consequent encouragement of sectional and parochial views, receive strong comment, and here again it is urged that the areas of local authorities should be re-drawn to give larger and more effective units. In this the memorandum is clearly alive to the importance of maintaining local interest, attracting industry to take a larger share of this form of public service, and giving the local authorities wider and more effective scope for co-operation with the industrial community as a whole; its final recommendation is the formation of a local development organization to continue the study of these problems, to co-ordinate them and keep them before the attention of the Government, utilizing the experience of the pre-war North-East Development Board and subsequent experience.

The memorandum clearly fits into the pattern of post-war employment policies which was covered broadly by Lord Woolton's statement in the House of Lords on February 15. Like that statement, it visualizes the need for some measure of Government control at least during the first two of the three economic phases through which we must pass during the immediate post-war years, and of definite guidance if not control during the third phase. Once again it emphasizes the necessity for Government decision and the elaboration of a policy in regard to such matters as the location of industry, before either particular industries or regions can proceed to elaborate their own plans. Furthermore, any such plans must be related to a national policy and plan, and clear guidance must be given as to the principles on which national and regional plans are to be based. Only then, and when some real attention has been given to the way in which such developments will react on the position and resources of local authorities and their relation to the central Government, can a practical scheme and time-table of demobilization be worked out and explained to those concerned.

Lord Woolton's own statement was admittedly incomplete, for it disregarded the international aspects of employment policy, control of raw materials, trade and currency policy. None the less, the ground he covered, leaving out of account the Service ministries that will be concerned with demobilization, relates to policy which must come under at least six depart-

ments—the Treasury, the Board of Trade, and the Ministries of Production, Supply, Aircraft Production and Labour, apart altogether from the authorities concerned with building and physical reconstruction. The impossibility of fitting departmental policy and measures together, without the prior and clear enunciation of the main lines and principles of policy at the centre, in a way that will solve the long-term employment problem, and permit a smooth transition from a war to a peace economy could scarcely be demonstrated better. Nor can even the essential task of educating public opinion as to what is involved proceed until policy has thus been enunciated.

The necessity for such publicity is well brought out in an able analysis of the whole question of demobilization and employment, which frankly faces the general question of the depressed areas, contained in a broadsheet (No. 217) recently issued by Political and Economic Planning. The problems which will confront us in remobilizing for peace are examined in the light of the experience of the War of 1914–18, and while the necessity of striking a balance between economic needs and the desires of service men is recognized, the imperative necessity of a publicity campaign, planned with all the vision and skill at the Government's command, to explain the why and how of policy, is equally stressed. No scheme will avoid all difficulties, but if the situation is fairly and simply explained to the millions of service men and war workers, it would do much to temper impatience and to curb over-sanguine expectations.

The preliminary analysis in the broadsheet follows the lines of Lord Woolton's statement. For several years the demand for man-power will far exceed the supply; quite apart from war requirements in the Far East, massive dammed-up demands for peace-time goods will place a heavy load on industry for some time to come. Inflation rather than general unemployment will be the danger. Social equity and economic order alike will require a system of priorities, and these must be carefully balanced to ensure that demands are in harmony with industrial capacity.

Dealing first with military demobilization and viewing it as a part of the vast business of re-orientating the war economy, the broadsheet points out that military factors will determine the rate of discharge. With regard to the question whether the rate of discharge should be left simply to military considerations or further controlled by the availability of jobs, the broadsheet quotes with approval the official view that the rate should be governed solely by operational requirements. The principles governing the order of release are likely to give far more difficulty, and here the wisdom of public announcement by the military authorities at an early date of the general principles they propose to adopt, and the strict observance of the principles formulated, are of paramount importance. The first rational principle is that industry's needs should be paramount: the speed with which the wheels of peace-time industry can be restarted will depend in part on the availability of certain key men. Some enterprises will be unable to revive quickly unless they are able to obtain the services of skilled men now in the Armed Forces. To make personal and family status the only test might quickly lead to chaos. Some account must be taken of the industrial background at home, though none the less policy must be affected by what service men will regard as fair.

The essential proposals of the report on demobilization issued by the Liberal Party Committee are in striking harmony with many of the views of P E P. The features of the Liberal Party's report are the emphasis placed on the need for speed in carrying out demobilization, and the insistence on the improvement of conditions of pay and service in the Armed Forces so that it may be possible to recruit without delay a professional army for the maintenance of order abroad. The report urges that it is the negation of both democracy and justice to retain the principle of compulsion in relation to military service merely to avoid the introduction of adequate scales of pay.

Plans for re-settlement in civil life are of capital importance in any demobilization scheme, and this report and the broadsheet both stress the necessity for opportunities for re-training and education. The report would make the continued receipt of pay and allowances, and certainly of unemployment benefit, after the first three months, conditional on attendance at training centres by those who had been unable to obtain civilian employment, while the broadsheet urges a serious effort to mobilize as many teachers as possible for this purpose. The Government plans are welcomed, especially the appointment of the strong committee under Lord Hankey to advise the Appointments Department of the Ministry of Labour. The debates on the Reinstatement in Employment Bill have made it plain that reinstatement is only part of a bigger problem. The crux of the matter is to ensure employment, and the broadsheet, in discussing what may be termed the reception end, suggests that the employment exchanges must be made both more efficient and more acceptable to employers and employees alike than they were before the War. It is also suggested that the exchanges might draw on Army experience with intelligence and aptitude tests for fitting the right man to the right job, and take over some of the trained Army personnel. Records which have been accumulated by the Services should be made available to the exchanges, so that they have information not only about a man's technical training and service experience but also about his general aptitudes.

Turning then to the question of industrial employment, the P E P broadsheet has no hesitation in assuming that a high demand for labour will continue. Apart from the military demands for the War in the Far East, production in general may not slacken nearly so much as many people think; there will be a vast demand waiting to be satisfied in the civilian field, and there will be keen competition to utilize any resources which may be released from the war effort. Export, for example, must rank as a high priority. It is of the first importance that Britain should not let domestic demands so swamp productive capacity that export markets are lost by default. Consumers will also wish to make good the accumulated deficiencies of war-time, and there will be the more

serious deficiencies in the nation's capital equipment to make good, notably in building; finally, Britain will have to bear her share of the cost of relief for the great areas of the world which have been devastated or impoverished by the Nazis or the Japanese.

The great problem in the view of P E P will be how to secure enough labour for the jobs that will need doing—for continued military production, for exports, for housing, for the manufacture of consumers' goods for relief. Accordingly, it will be essential for the Ministry of Labour to retain its powers under the Essential Work Orders. As a consequence of the prevailing shortage, the labour factor will continue to be of high importance in the general economic strategy, and the position of the Ministry of Labour as pivotal as it has become in the later stages of the War.

Two provisos are made to the general proposition that there will be a shortage of labour for some years after the end of hostilities in Europe. First, as already indicated, some temporary unemployment due to the transition from one type of production to another, and from war to peace production, is inevitable. Secondly, employment opportunities will not necessarily be distributed in accordance with the supply of labour. There may be pockets of unemployment, and the Northern Industrial Group in its memorandum directs attention to this outstanding danger which may threaten other areas besides the north-east coast of England.

P E P urges that it should be one of the great aims of Government policy to encourage industrial development in these areas. The end of the War should provide a great opportunity to establish in the former Depressed Areas new enterprises giving a better balance between foreign and home markets, and between light and heavy industries. The Government's many powerful instruments of control place it in a strong position to prevent local unemployment either in the short or in the long run. As the chief customer for most of the country's industry, the Government will possess in the process of terminating its contracts a strong lever which could be used to minimize or prevent local unemployment. The disposition of plant and equipment owned by the State and the power to license materials could all be used to prevent local unemployment, for example, by implementing trading estates, new centres of light industry and developing new processes and raw materials, as the president of the Board of Trade has already indicated.

Despite the complexity of the problems involved in military demobilization and industrial re-adjustment, there is therefore no reason for pessimism as to the employment situation in Great Britain; there should be little danger of general, though there will be some danger of local, unemployment. The process of adjustment can, however, only be made tolerable by planning, and by the retention of some at least of the measures of war-time control. If that is to succeed, the reasons for planning and control must be made plain to all, and their purpose clearly and honestly explained. That is as essential as it is that the Government should make its decisions and announce its central policy as early as possible, so that regional and local action is possible in harmony with the national plan, and as large a measure of initiative and freedom afforded to local enterprise as is consistent with orderly transition from war to peace.

JUDGMENT ON PLANNING

TVA

Adventure in Planning. By Prof. Julian Huxley. Pp. 142. (Cheam: Architectural Press, Ltd., 1943.) 8*s*. 6*d*.

THE Tennessee Valley Authority has now been established for ten years, and the experience of a full decade renders possible an attempt to assess its achievements and their significance, both in relation to the problems of regional planning in Great Britain and to the no less difficult range of administrative problems involved in public control and the relations between local and central government. In giving us the first detailed account published in Great Britain of this achievement, Dr. Huxley provides an admirable complement to Prof. C. Herman Pritchett's "The Tennessee Valley Authority: a Study in Public Administration", copies of which only now appear to have reached this country, although it was published in the United States in 1942.

Prof. Pritchett's book, as its sub-title indicates, is in the sequence of Prof. R. E. Cushman's study "The Independent Regulatory Commissions", from which consideration of the Tennessee Valley Authority was expressly excluded. It is concerned essentially with the political and administrative problems of the venture and makes a striking appendix to the report of the President's Committee on Administrative Management. Dr. Huxley, on the other hand, while not ignoring these aspects, places his main stress on the social and broader technical aspects of what he rightly terms an experiment or adventure in planning. His able presentation of the whole range of problems, and his skilful and lucid delineation of the fundamental questions or principles involved, coupled with the admirable photographs with which the book is illustrated and a good bibliography, should make his book as welcome to the serious student as to the general reader.

For the scientific worker, this account of the use of the scientific method of research, survey and experiment in dealing with great and complex social and economic problems is of special interest. Even those who have some knowledge of the achievements of the Tennessee Valley Authority in regard to power supply and to soil conservation may well be surprised at the picture Dr. Huxley gives of the effects of this great experiment on agriculture, health, labour, education, architecture and design. From the outset, the Authority has realized the enormous potential value of its reservoirs for recreation, and from this has proceeded to plan for the same development of all aspects of recreation in the Valley. No section of Dr. Huxley's book is more suggestive at the present time than that in which he describes the work of the Authority in regard to parks and wild life, and it deserves the close attention of all those concerned with present proposals for nature reserves or national parks in Britain.

Continuous research and survey are the essence of any large-scale planning, but many scientific workers will learn for the first time in these pages of

the wide range of research for which the Tennessee Valley Authority has been responsible in the ten years of its existence, apart altogether from its basic surveys of the mineral and agricultural resources of the Tennessee valley. Particularly is this true of its research at the consumer end, for example, on the design of agricultural machinery suited to the physical and economic peculiarities of the region; while Dr. Huxley's reference to the archæological investigation of the area to be flooded at the Pickwick Dam site, directed by the Authority in co-operation with the University of Alabama, makes a startling contrast with the way in which we have permitted quarrying to endanger the Roman Wall, to name only one recent example.

Dr. Huxley's account of the achievements of the Tennessee Valley Authority is the more impressive because he brings out the dangers or weaknesses as well as the advantages of regional planning on this scale. Compulsory powers, he points out, should never constitute more than the skeleton of planning. The living plan itself must evolve and grow, and can only do so on the basis of co-operative participation—both co-operation with other Government bodies and official and unofficial agencies, and co-operation with the people of the region, through arousing their sense of participation and making them feel that it is their plan and that they have a real share in bringing it to fruition.

It is for the way in which it has endeavoured, largely with success, to secure such co-operation that the Tennessee Valley Authority is of such prime importance in relation to post-war reconstruction. Its decentralized administration, as Dr. Huxley emphasizes, gives it a further claim to close study in this connexion and has contributed largely to its success. The way in which this has been achieved—by making the greatest number of decisions on the spot, by developing so far as possible the active participation of the people themselves, by co-ordinating in the field the work of all other agencies concerned, and by decentralizing the idea behind an administration so that its planning becomes a part of public opinion—has a vital bearing on those problems of centralization, regionalism and local control with which we are already being confronted in almost every one of the fields in which we are tentatively approaching the problems of the post-war world.

Dr. Huxley himself indicates the significance that this great experiment has for such war-time developments as the Middle East Supply Council or the Caribbean Commission, or for such suggestions as that for a post-war Danube Valley Authority. Readers of Dr. Huxley's book should be able to form some independent opinion as to how far Mr. Hugh Quigley is right in his contention in a recent article in *Agenda*, on "The Highlands of Scotland: Proposals for Development", that the riches of the Highland landscape, life and enterprise should be enjoyed as a national possession or in his suggestions for their preservation.

Dr. Huxley's book should stimulate much fresh thought about this and other problems of depressed areas and regionalism in Great Britain. Its topical bearing, no less than its admirable presentation, should ensure it a place on the shelves of all concerned with problems of reconstruction and regional planning, and the application of scientific method in the solution of social and economic problems.

R. BRIGHTMAN.

THE SOCIOLOGY OF CRIME

Race and Crime

By Willem Adriaan Bonger. Translated from the Dutch by Margaret Mathews Hordyk. Pp. xi+130. (New York: Columbia University Press; London: Oxford University Press, 1943.) 10*s*. net.

FROM 1922 until his death in 1940, Willem Bonger was professor of sociology and criminology in the University of Amsterdam. To psychologists and criminologists he is best known from his "Introduction to Criminology", the outcome of his life's work. In that volume, as in his earlier contributions, he showed himself a keen and critical champion of the view that crime must be regarded as a social or psychological rather than as a medical or biological problem. This was in effect a revolt against the views of the 'anthropological school' of criminology, which, under the leadership of Lombroso and his Italian followers, still dominated the psychology of crime when Bonger first began to write. His last book, on "Race and Crime", deals with what he terms the 'neo-Lombrosian theory'. Mrs. Hordyk received the manuscript only a few days before Holland was invaded, and has produced a most competent and welcome translation.

Dr. Bonger begins by pointing out the highly unscientific way in which the term 'race' has been used, even by anthropologists of repute. An adequate definition, he maintains, ought to imply, not only that the members of the race possess a number of physical and mental characteristics in common, but also that these common characteristics are inherited. Language, the chief criterion of older writers, is not inheritable; and the physical characteristics by which recent anthropologists have attempted to distinguish existing 'races' are in his view "comparatively superficial", and can be but remotely connected with differences in mind or conduct. Moreover, as he observes, when races intermarry, their physical characteristics, such as the determinants of hair and eye colour, may frequently fail to blend; but mental characteristics almost invariably show blending, with a 'normal' rather than a bimodal distribution. Hence groups that may appear to be racially pure when judged by physical criteria may, in point of fact, prove to be highly intermingled when we compare their innate traits of intelligence and temperament. Above all, whether innate or not, "in the psychological sphere, individual differences between members of the same race are so great that differences between races themselves are by comparison small".

The bulk of his book consists in an analysis of recent criminal statistics collected from various countries, and classified according to presumable racial origins. In Europe, for example, during 1927–32, the number of persons convicted of murder and manslaughter per 100,000 of the adult population varied enormously in different countries—from 0·2 in England and Norway to 22·3 in Bulgaria. Broadly speaking, the frequency of such crimes appears lowest in the north-west (though Ireland is a minor exception), somewhat higher in the central areas, higher still in the south, and highest of all in the Balkan and east Baltic areas. At first sight this seems consistent with theories, like that put forward by Kurella and more recently maintained by Martin, to the effect that the Nordic races are freest from crime, the Alpine races nearly as free, the Mediterranean

races decidedly more prone, and the Slavs most liable of all. A more detailed examination, however, shows that, within each country, both the frequency and the nature of the crimes are far more closely related to historical, social, and economic differences than to racial: thus in remote agrarian districts, where material and cultural poverty prevails, crimes against property as well as persons are comparatively common, regardless of racial or national differences; again, in countries where until recently semi-feudal conditions obtained, and particularly where the tradition of private vendetta has survived, homicide is by no means infrequent. The Jewish record for theft, for sexual misdemeanours, and for every type of serious aggressive crime, is everywhere remarkably favourable; on the other hand, commercial crimes are about half as common again among Jews as among other inhabitants of the same country in question. Yet once again these differences are chiefly due to records from urban and commercial areas; and, when local variations are more closely studied, it appears that the offences of the Jews show a marked inclination towards those typical of the areas in which the different Jewish communities are found.

Among immigrants to the United States, the figures for different nationalities at first sight show a general correspondence with those reported from their respective home countries. But this holds true only of the first generation or two: thus, among children of Italian parents who were themselves both born in America, the figures drop practically to the level of native Americans. For Negroes the proportions are nearly three or four times as high as they are for whites; yet, as Dr. Bonger shows by detailed quotation, most American criminologists are agreed that the social and economic conditions under which the Negroes live go far to offer an explanation of the facts observed.

From these and other statistical data, Dr. Bonger finally concludes that differences in racial intelligence and temperament cannot be wholly excluded; but he considers that their influence is remote, indirect, and "sorely exaggerated". Crime, as such, is not inheritable. But there is reason for believing that it "proceeds from instincts common to all men", and that different races may inherit those instincts with differing intensity. Accordingly, although such minor differences in instinctive propensities "have in themselves no necessary connection with crime, still, in certain social circumstances", he holds, "they might impart a stronger anti-social bias to certain members of the population". CYRIL BURT.

FAT METABOLISM

The Metabolism of Fat

(Monographs on Biological Subjects.) By Dr. Ida Smedley-Maclean. Pp. vi+104. (London: Methuen and Co., Ltd., 1943.) 5*s*. net.

THERE is a considerable lack of comprehensive up-to-date monographs on biochemical topics, and especially on fat metabolism. The present book was intended to fill this gap in the field of fat biochemistry and to provide students, especially those with little or no previous knowledge of the subject, with a short account of the present-day knowledge on fat metabolism. The author deals briefly in seven chapters with the synthesis of fatty acids, the constitution and the role of the unsaturated fatty acids in the organism, the oxidation of fatty acids *in vitro* and *in vivo*, the constitution of lipoids and the transport of fatty acids in the animal body. A list of references and a short subject index conclude the book.

The author was aware of the impossibility of giving a complete survey of the field in so short a space, and has succeeded in many respects in giving a clear picture of the broad outlines of our knowledge on the subject. In a number of instances, however, the highly controversial and far from complete picture of fat metabolism is over-simplified and the gaps in our knowledge are filled with a disproportionately long account of current theories. Thus, for example, the views on the possible mechanism of fatty acid synthesis are expounded at some length, which no doubt gives the reader a simple view of the subject, but one little supported by experimental evidence. Also the treatment of the subject of oxidation of fatty acids does not give a balanced view of the experimental evidence and the numerous theories. In the chapter on fat transport in the animal body considerable stress is laid on the theory of Verzar, although many of his results have not been confirmed by other workers.

There are a few errors in chemical formulæ (pp. 78, 79) and in the indexing of references.

A. KLEINZELLER.

ELECTRONIC THEORY IN CHEMISTRY

Electronic Theory and Chemical Reactions

An Elementary Treatment. By R. W. Stott. Pp. viii+112. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1943.) 6*s*. net.

IN the last two decades, the interpretation of reaction mechanism from the point of view of the electronic theory of valency has advanced apace, and the rapid growth of the original literature on the subject has made it difficult for those not primarily engaged in its furtherance to keep abreast of the developments. To some extent this difficulty has recently been met by the appearance of a number of summarizing articles and a few books. In the booklet under review we have the latest addition to this collection.

In six short chapters entitled "Inorganic Compounds", "Organic Acids and Reactive Hydrogen Atoms", "The Mechanisms of Certain Types of Reactions of Organic Compounds", "The Structure of Benzene and other Aromatic Compounds", "Substitution in the Benzene Nucleus", and "Some Uses of Radio-active and other Isotopes", the author attempts to give a brief sketch of the theory of chemical reactions. This is a formidable task, but, though the treatment is in parts somewhat over-simplified, and is not free from errors, the book will undoubtedly be found useful as an elementary introduction to the subject. It is intended mainly for the use of first-year students, for others who have but limited time for reading, and, possibly, for advanced sixth-form pupils. In his preface the author writes: "If this book stimulates interest in what is an attractive subject, and encourages further reading and investigation, it will have fulfilled the purpose for which it has been written". It is the reviewer's opinion that the book will achieve this object.

E. D. HUGHES.

NEOLITHIC FOREST CLEARANCE

By DR. H. GODWIN
Botany School, Cambridge

IT is the first approximation of the ecologist to relate the control of distribution of major vegetational types to major climatic types : only later does he advance to consider how human activities have interfered with and complicated the pattern determined in the first place by climate. The same relationship has held for the study of palæo-ecology by the methods of pollen-analysis. We have firmly established the general picture of forest movement across north-west Europe under the compulsion of changing climate, and now comes the phase when for the first time we seek to recognize, by pollen-analysis, the role of prehistoric man in changing the natural forest cover of Europe. We are brought to recognize this new phase by a recent publication of Johs. Iverson in the series of the Danish Geological Survey*, on "Land Occupation in Denmark's Stone Age".

Iverson begins with the thesis that Palæolithic and Mesolithic men were hunters and fishers, who modified very little the natural vegetation of the lands they so sparsely occupied, and indeed the application of the term 'forest culture' to the Mesolithic implies that the forest dominated man, and not the other way round. With the introduction of farmer culture to Denmark by the invasion of Neolithic man this state of affairs was radically altered, and Iverson seeks and finds evidence for this change in a striking series of pollen investigations. The dating of this change to the Neolithic period can sometimes be directly established ; but more often it can be recognized from the pollen diagrams themselves. It is already well known that the Neolithic in Denmark falls in the middle of the oak-forest period in which oak, elm, and the linden together formed the high forest, with alder and birch in the wetter places and pine and birch in the drier. Iverson points out that pollen of the Ulmus (elm) in the middle of the oak period shows a conspicuous and consistent fall from uniform high to uniform low values. He has, by very laborious counts, shown that the far less frequent pollen of the ivy (*Hedera helix*) shows a very similar decrease at the same time, while the pollen of ash (Fraxinus) increases. This diminution in abundance of such a strongly Atlantic species as the ivy is considered by him to indicate the climatic change from the so-called 'Atlantic' to the 'Sub-boreal' period, a change agreed to fall very near the opening of the Neolithic in this part of Europe. There is no doubt that the fossil elm pollen in Britain gives every sign of coming from a tree with preference for an oceanic climate, and the sudden diminution of its frequency has been already recognized here, as in other parts of north-western Europe, as a trustworthy horizon.

Iverson now points out that in many Danish pollen diagrams, just above this clear climatically determined horizon, the pollen curves indicate a very sudden and peculiar change in forest composition. This is perhaps best shown at Ordrup Mose, where a layer of charcoal stratified into the marginal nekron-muds of a former lake give evidence of burning, and thus perhaps, indirectly, of human occupation. At this level the elements of the high forest, Quercus, Tilia, Fraxinus and Ulmus, undergo a distinct but temporary decline, while Betula reveals a transitory, Alnus a more lasting increase, in pollen frequency, and at the same time the Corylus (hazel) curve reaches a very pronounced maximum. Iverson assumes that these pollen-floristic changes "express the vegetational developments in a region where land-tilling people have occupied the land and cleared this dense primeval forest with axe and fire". The decline of the high forest tree-pollen curves is due to local destruction ; the rise of birch, alder and hazel afterwards is due to the rapid regeneration of these species in cleared areas, partly from stumps and partly by their seeds, which, especially in birch and alder, facilitate quick dispersal.

This interpretation receives support from several directions. First is the actual charcoal layer at Ordrup. Second is the fact that at this level the *absolute* tree-pollen frequencies (per unit surface of prepared slide) fall suddenly to very low values and then slowly recover.

Thirdly, Iverson produces striking evidence from the examination of the non-tree pollen content of the lake deposits. Just above the charcoal layer the sum of the non-tree pollen increases suddenly just as one would expect by his hypothesis, but especial importance is attached to his identifications of the species contributing to this total. It had already been pointed out by Firbas that the pollen of cultivated cereals could in general be distinguished by its size and associated characters from that of other grasses, and Iverson shows that continuous though low amounts of cereal pollen are represented in the Ordrup profile above the level of sudden oak forest diminution. Along with this there begins a substantial and continuous curve for the pollen of Plantago, the common plantains, of the species *P. major* and *P. lanceolata*, which have always been very strongly associated with human disturbance of natural vegetation. In addition to this the pollen of Artemisia reaches high percentages, and Iverson suggests that this is probably due to *A. vulgaris*, which was a serious weed in Denmark until the practice of deep ploughing became possible. In several bogs of small size Iverson has been able to show the sudden minimum in the oak forest pollen curves, together with the associated rise of anthropochorus plants, forming an episode so "sudden and brief" in the pollen diagram that it can be taken as indicative of the vegetational succession after local occupation by man and only short-lived settlement. In the deposits of larger fiords or lakes the tree-pollen curves show less sudden disturbances, although the 'weed' and cereal pollen begin continuous curves at the usual level. It is reasonable to consider that pollen diagrams from such places reflect a generalized picture of a whole series of forest clearances over a large tract of countryside, and here, no doubt, it is much less easy to attribute the changes in pollen frequency to the single cause of human interference.

Iverson points out that when the initial phase of disturbance is past, the general forest composition shows little sign of permanent alteration until the beginning of the Early Iron Age. This constancy he is inclined to attribute to the type of forest exploitation practised by the Neolithic settlers, and he speculates that they may well have used the clearance fire to provide not only space for the cultivation of cereals, but also areas of rich herbaceous vegetation and tender tree and shrub shoots to serve for cattle grazing. It is recalled that similar employ-

* Landnam i Danmarks Stenalder (Land Occupation in Denmark's Stone Age). By Johs. Iverson. Danmarks Geologiske Undersøgelse II Række. No. 66. Pp. 68+9 plates. (Copenhagen, 1941.)

ment of clearance fires still continues in backward parts of Europe, and that the Danish archæologist G. Hatt had already indicated the probability that it was in use in prehistoric Denmark.

It follows naturally that if we accept the argument of Iverson thus far, we must expect to find that when the 'Sub-atlantic' climatic period began, no less important vegetational changes took place. For at this time not only the swift climatic 'deterioration' occurred, but also the establishment of a new people with iron implements and the permanent regular settlement associated with village culture. In fact, Iverson is able to demonstrate that the pollen diagrams and peat profiles do reflect such changes. There is the extensive water-logging of low-lying land and the formation of aquatic 'precursor' peat with *Scheuchzeria palustris* above the uniform and highly humified Sphagnum-Calluna peat of raised bogs, and there is the considerable extension of Fagus (beech) at the expense of Quercus (oak) in the pollen diagrams. Both these are climatic effects. In addition, there is a progressive forest destruction by human activity which is indicated by a further considerable increase in the pollen of herbaceous plants, and, in the heathy areas, by increase in the pollen of the ling, *Calluna vulgaris*. The pollen diagrams indicate that in the heath region of central Jutland it was not until the Early Iron Age that great and continuous areas of heath were formed, although some heath was doubtless produced by Neolithic and Bronze Age clearance, and even in Pre-neolithic times the woodlands were much more open than those on the heavier soils.

Iverson's most stimulating piece of research emphasizes what was already dimly recognized, that an *ecological* approach to the interpretation of the results of pollen-analysis is logical and profitable, and indicates that the pollen-analysis method has proved its flexibility by application to yet another aspect of post-glacial history. We may now look for confirmatory results in this special field from many other parts of Europe.

ANCIENT ASTROLOGY

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IN A.D. 1605 Sir Francis Bacon appended to the "Advancement of Learning" some prescriptions for posterity. These contain an injunction to construct "A Just Astrology". Bacon had previously assessed the then condition of this science in his main text. Like alchemy, astrology had a noble aim; like alchemy again, it had been more imaginative than rational; and, once more like alchemy, it needed the corrective and the purge. Astrology, as Bacon conceives it, is central and fundamental, for he defines it as "the real effects of the celestial bodies upon the terrestrial". This includes the action of the sun on the earth: without which there would be no astrology, because there would be no astrologers.

Posterity has obeyed Bacon in one way by sharpening and deepening its sense of absolute dependence on the sun. The cosmic course has made continuing human life possible by isolating the humble solar system in the vastness of space, and by placing the modest earth, with all its appropriate conditions, in nice adjustment to the solar rays. If the sun cooled down, mankind would freeze out; if it exploded into a fierce burst of radiation, the earth would become a great crematorium. If an invading body tore the earth too far away from the sun, or the sun from the earth, men would freeze; if it drove the earth and sun too near, or collided with the sun to make too fierce a furnace, men would burn. Invaders have far to come to reach an earth 4½ light-years away from the nearest star and very remote from the galactic depths. Though the importance of the sun is too obvious to be missed, the ancient mind probably grasped man's absolute dependence on it less completely than modern astronomy.

Plato's "Timæos" is very preoccupied with the sun as a measure of time, a revealer of number and a teacher of arithmetic. The moon, the planets and their motions share in the lessons. The Platonic Socrates, however, gives the sun its due in the "Republic" as the author of visibility, generation, nourishment and growth, though the sun itself is not generated. Modern astronomy, or, in Bacon's sense, astrology, does not confine celestial actions to the sun. The moon pulls more than the sun at the tides to produce their effects—on navigation, for example, or on some marine organisms. The cosmic rays still have their enigmas. If they do come partly from the stars and do act on genes, modern astrology will recognize some stellar influence. According to Aristotle's "De Cælo", the moving celestial bodies emit heat and light by rubbing against the air. The "Meteorologica" supplements this. Neither the moon nor any star gives out much heat: the moon is near but too slow, and the star is rapid but too far off. The sun is both swift enough and near enough to warm the earth well. Though the two passages claim little for non-solar influences, they do indicate how readily celestial bodies could be presumed to affect the earth. The ancient mind did, in fact, as ancient astrology shows, very liberally supplement the celestial action of the sun.

Greek science, including astronomy, began on May 28, 585 B.C.: Thales predicted an eclipse of the sun for that day, and Nature obligingly darkened a battle between the Lydians and the Medes. This statement is too dramatic to be literally true, but Thales and the eclipse conveniently date the still accepted origin of Greek science (and philosophy) in the sixth century B.C. Thales was lucky, as Heath notes, for the Babylonian period on which he depended is less reliable for solar than for lunar eclipses. In 2159 B.C. the Chinese astronomers Hi and Ho were unlucky. Thales predicted an eclipse and gained prestige; Hi and Ho did not predict an eclipse and were executed.

From Thales the current of science runs to one great decisive century of thought—the fourth century B.C., the century dominated by Plato and Aristotle. In drastic summary, and so far as possible from the scientific point of view, a mathematical tradition runs from the anti-experimental Plato and a second trend of thought runs from Aristotle. Mathematics had its hand in astronomy and astrology. Science reaches an acme in the third century. In mathematics it includes Euclid and Archimedes; in astronomy it includes Eratosthenes, who measured the earth's diameter very accurately, and Aristarchos, who anticipated the Copernican theory. Herophilos founded scientific anatomy and Erasistratos founded scientific physiology. Then science begins to run into relative, though recognizable, termini. In the first century B.C. Lucretius stores the fundamentals of atomism in his famous poem, "De Rerum Natura",

for still far future centuries. Fortune has been capricious towards atomic theories. When the atoms tried to enter physics they were soon defeated; their more determined attempt to enter medicine was finally foiled by Galen at the end of the great Greco-Roman period in A.D. 200. Many centuries after, the atoms became an extraordinarily fertile concept—one of the most fertile, perhaps the most fertile, of all physical theories.

Science is considerably consolidated from the first century B.C. to the first century A.D. in such writings as those of Cicero, Vitruvius and Plutarch. In the first and second centuries A.D. science drops into four relatively permanent and authoritative consolidations. In A.D. 77 Pliny pours a miscellany of facts, presumed facts and ideas into his "Natural History"—that "immense register", as Gibbon says, in which were "deposited the discoveries, the arts and the errors of mankind". It had its own authority and its own influence over future centuries, though it does state that elephants worship the stars.

Clarke, in his translation of Seneca's "Quæstiones Naturales", under the title "Physical Science in the Time of Nero", calls it the last deliverance of the classical world on physical speculation. Seneca authoritatively consolidates physics for coming centuries.

Singer, in "A Short History of Science", heads his chapter on the divorce of science and philosophy, from 300 B.C. to A.D. 200, "The Failure of Nerve". This expresses the decline of science rather oddly, for Ptolemy and Galen, in the second century A.D., are experimental and have at least a notion of the nature of scientific hypothesis. If the "Optics" as now known is as Ptolemy wrote it—and Thorndike thinks it is so substantially—it represents the most remarkable experimental research in antiquity. The oddness seems less when a candle is seen to flicker up before it dies. Science has before it the long path through the Middle Ages to the decisive seventeenth century. Ptolemy's consolidation of astronomy remains authoritative until Copernicus and Kepler in the sixteenth and seventeenth centuries. Galen's great biological, anatomical and medical synthesis, which includes his own inductive and experimental inquiries, remains authoritative until the sixteenth-century Vesalius. Seneca, the neo-Stoic, Ptolemy, the mathematician and astronomer, Galen, the physician—each consolidates the results of science in his own way. They have one belief in common—the control of human destiny by the planets and the stars.

In 1609 Kepler introduced the elliptical planetary orbit. This decisive step effectively made the transition from the geocentric Ptolemaic system to the heliocentric Copernican astronomy. Astrology had persisted during fourteen centuries after Galen, for Kepler still checked his own horoscope on his own life.

The horoscope displays the dispositions of the celestial bodies, or relevant celestial bodies, at a particular moment. When Johnson accused Dryden of "great confidence in the prognostications of judicial astrology", he meant that Dryden believed in the casting of nativities and even calculated them himself. Such *judicial* astrology casts the horoscope of birth or conception to determine the destiny of the born. Webster's "New International Dictionary" (1914) distinguishes *judicial* astrology, which predicts the destinies of individuals or nations, from *natural* astrology, which predicts natural events. Bacon included horoscope astrology in his purge. Seneca and Galen include the horoscope in their doctrine, though Galen's astrology is largely medical. Ptolemy describes the philosophy of horoscope astrology.

Nothing is too strange or incredible for some philosopher to believe—so judged the young Descartes when he was at college. Men have believed very many strange things, and perhaps they still do. A universe created as a compact mass and expanding from its terrific initial concentration may be among them. A modern cosmologist fortifies the doctrine by mathematics and dates the primal pack so far as 2×10^9 years ago. Horoscope astrology, however, is too significant a phase of thought to be eyed merely as a curious error.

Human thought has been fated to tread a predestined path, as an acorn steps its way to the oak. This is a good working principle if taken widely, if used in Sir Thomas Browne's "soft and flexible sense" and if not made a fetish by reason. The mind seems to have been committed to a magical phase, for example, though not to every magical detail. In any event, the route to such insight as has been attained has been through many illusions and errors. This is true of astronomy and astrology. The historian should consult the acorn and be wise, for the phases of thought should be contemplated as acorns and not merely chided for not being oaks. The future historian will probably see many acorns in the twentieth century—some promising, some sterile. Discarded hypotheses strew the devious path of science, and many astrological notions lie among them. These notions have at least one value still, for they give glimpses of the mind at work. Analysis conveniently derives them doubly from the concepts of their time and from impressions made by natural phenomena, though the two are ultimately and intimately connected.

Most men accept happiness as the chief good, though they disagree about its nature. This statement from the opening pages of Aristotle's "Ethics" has a modern ring. An otherwise well-educated man who knows nothing of Greek thought might conceivably mistake the "Ethics" or "Rhetoric" or "Poetics" of Aristotle for a modern work. This peculiarly educated man is a legitimate expository expedient to point a contrast. "A man's language ought to be easy for another to read, pronounce and point": this sentence from the "Rhetoric" is modern enough. So is the notion adopted from Agathon in the "Poetics": it is probable that many improbable things will happen. The supposititious reader would never mistake Aristotle's "De Cælo" or "Meteorologica" for a modern work. Intelligent stars, the roles of the four elements, easily credited spontaneous generations, for example, and the whole range of physical ideas date the two works relentlessly. Physics, in one very real sense, is the most fundamental science. It is very fundamental if men emerged from the cosmic course among the ephemeridæ of the universe. Greek philosophies almost invariably had their physics, and the earlier philosophies, at least, if they were assessed for the first time to-day, would probably be called philosophies of physics, as Eddington calls his work "The Philosophy of Physical Science". The physical world is more alien to us, in a recognizable sense, than the more domestic circle of human experience. Aristotle can deal with courage in the "Ethics", for example, or with the qualities of metaphors in the "Poetics" and the "Rhetoric", with more immediate success than he can secure in physics. A defective physics is one important item in the conceptual system that

promoted early astrologies. Greek philosophies regularly had their astronomies and astrologies.

Prospero's isle seemed to Caliban to be full of noises; the universe seemed to Seneca and Ptolemy to be pervaded by forces. The four traditional powers—dry, moist and, eminently, hot and cold—dynamically inter-connect the earth and the celestial bodies in the Ptolemaic universe. The heavens also send a force on to the earth. In Seneca's cosmology lightning has its subtle divine power, underground forces convert air into water, and a mighty force pervades Nature. Seneca's *force* is constantly modelled on the air, and the air itself, in various forms, is for him virtually a ubiquitous agent. It is the greatest of all powers for it kindles fire. The air drives trees up, holds our bodies together and stirs our souls, themselves a kind of air; a robust air keeps the earth compact and a fresh vital air from the earth supports life. The breath of the earth sustains the sun, the stars and the whole heavenly concourse. The inverted astrology of this statement contains a vivid sense of pervading cosmic forces. A crude physics assists this sense, and the cosmic spread of air provides an astrological agent.

Britain is great through the muscles of her sons, beef feeds the muscles, clover nourishes the cattle and bees fertilize the clover. Field-mice would destroy the bees, but cats kill the mice and old maids make Britain because they keep the cats. An item in the Hippocratic writings, whenever it was inserted, expresses the interconnexion of things less facetiously: if any one thing perished, all things would vanish. Every event, says Seneca, is a sign of an event to come. The sense of interconnected events is vivid in Stoicism.

Einstein's "cosmic religious feeling", stirred by the "sense of universal causation" and "the harmony of natural law", has its ancient analogue in the sense of the divine. In the "Apology" Socrates affirms a universal belief in the godhead of the sun or moon. Anaxagoras had been indicted because he called the sun a red-hot stone and the moon an earthy mass. In Plato's "Laws" the Athenian Stranger claims divinity for the sun, moon and stars against the earth and stones of mischievous philosophers. In the "Timæos" the stars and the planets are created gods; for Aristotle the stars, made of purest æther, are intelligent and divine. The divinity of the celestial bodies, as gods or godlike, persisted from Babylonian and Egyptian lore through the Greco-Roman tradition far into the Christian era. As Thorndike notes, Seneca studying the natural forces suggests the worshipper in the temple.

The Stoic Fate, however finally assessed, embodies two compelling concepts. It contains the belief in determinate causal connexions and natural law that emerged in Greek thought as the working faith of science. It contains also the sense of purpose, or aiming at ends, from which the Greek, or Greco-Roman, estimate of *cause* seldom got far away. Atomism had affronted this sense of the purposive too much to be welcomed for its sense of strict causality when Galen gave it the *coup de grâce* in medicine.

The ancient universe is physically misconstrued, pervaded by forces, interconnected throughout by determinately connected causes, a realm of natural law, a domain of sympathies or antipathies, suffused with purpose and impressively divine. "Astrology fell upon the Hellenistic mind as a new disease falls upon a remote island people": so writes Sir Gilbert Murray. Men realized truly that astronomy must finally achieve an astrology of some sort, though they tried to achieve it too quickly by inadequate means—this is a fair précis of a paragraph from Coleridge. The stars probably do mean something, John Selden thought in the seventeenth century, but astrologers cannot get at them to determine what. The stars *do* mean something and something can be known about the *what*—so thought Seneca, Ptolemy, Galen and many ancients.

Thucydides records how a lunar eclipse kept an Athenian host in port until the twenty-seven days prescribed by the soothsayers had passed. Samuel Pepys looked more imperturbably on the unfortunate comet that had lost its tail than many other eyes had looked on other comets. Eclipses, comets and many other astronomical or meteorological items took a hand in promoting astrologies. One item, in particular, had as many hands in the matter as Briareus. Pepys was recompensed for his toilsome studies of the moon's motions when it lighted him home on a dark night. Tiberius hoped to save his shorn poll from baldness by having his hair cut as the moon waxed. The belief in lunar control, the response of things or events to the lunar wax by increase and to the lunar wane by decrease, began early, extended to innumerable items and persisted pertinaciously.

Aristotle refers to the presumed connexion between moon and menstruation which runs through the tradition. In Galen the lunar phases still rule conception, birth and the "beginnings of actions": a belief rich in astrological possibilities. The innocent indifferent moon, which presumably knows nothing of such speculations, has been suspected of setting the whole astrological system going—horoscopes and all.

Neither Pythias, in the later fourth century B.C., when he correlated the lunar phases with the tides, nor Posidionius, about the first century B.C., when he recognized the combined tidal action of the moon and sun, drove the moon out of horoscope astrology. The moon hauls the tides; according to Galen it changes the air. If polluted air spreads disease, and the Hippocratic "Breaths" refers both life and sickness to the air, it may be infected from the skies. Pestilence can come from the sky if atoms from the great beyond can derange the air, as Lucretius sings, or atoms from the celestial bodies can spread epidemics, as Democritus affirms. Though the atomists are condemned by Galen for refusing astrology, they can accept widespread celestial actions by invading atoms.

In Aristotle and Galen the air connects the earth with the heavenly bodies. Under "Astronomy" in James's "A Medicinal Dictionary" (A.D. 1743), the sun, moon, planets and stars are said to act on terrestrial bodies through the æther and the atmosphere: even the distant stars affect human bodies by disturbing the air. Astrology, horoscopic or non-horoscopic, constantly trusts in the moon's power and relies on the astrological agency of air.

The astrological tradition is perceptible in the "Timæos", in the terrors sent and intimations given to expert calculators by the combined motions of the planets. The horoscope invades Stoicism, Rome and Greco-Roman thought during the second and first centuries B.C. Two dissentients mark the invasion: Panætios the Stoic in the second century and Cicero in the first. The signs of the zodiac connect modern astronomy with astrology and with

its origin, for they admittedly come from Babylonia. The tradition insistently refers the origin of astrology to the Chaldæans.

Berossos the Babylonian wrote a history of his country in the third century B.C. As the tradition appears in Vitruvius, for example, the Chaldæans cast nativities, Berossos presses their astrology on his school at Cos, Antipater and Archinapolos alter the horoscope from birth to conception, and astrology grips Greco-Roman thought. The encyclopædic history of Diodoros, about 30 B.C., describes the theory and method of the Chaldæans : the events of the heavens intimate the thoughts of the gods, so the stars were observed for many ages. So astrological theory promoted astronomy. The Babylonians are said to have checked horoscopes on the recorded lives of Babylonian boys. Even if they did this for less than the 470 years of one more moderate estimate, their inductive effort, if not their deductive doctrine, must be reckoned as scientific righteousness.

Did all the Romans who fell at Cannæ have the same horoscope ? Cicero's question sounds pertinent. When the birth of Firminus was nigh, a slave-woman of his father's house was also near her delivery. Messengers were posted in either house to run to the other with news of each birth. The two messengers met so exactly in the middle of the way that the two births must have happened at precisely the same instant. Yet, St. Augustine further records, Firminus was born to increasing riches and honours, but the slave-born child was born to continued slavery. Cicero and St. Augustine argue inversely against the horoscope : Cicero from one fate and different horoscopes ; St. Augustine from one horoscope and different fates. Either argument might be valid if, and only if, the disposition of the heavenly bodies at birth is the singly decisive decider of destiny. Ptolemy denies that it is singly decisive.

An anticipatory reply to St. Augustine can be shortly constructed from Ptolemy's "Tetrabiblos". Famines, pestilences, wars and the like, which affect large areas, whole peoples and cities, are more surely predicted than single human actions. The effect of the stars on the human individual is conditioned by his nationality, his country and his domicile. It is also conditioned by his period, for time varies the celestial actions. Firminus and the slave were born at the same time, in the same city and among the same people, but under different social conditions. They were also differently educated. Ptolemy disclaims an astrological narrowness if previous astrologers had ignored place, weather and heredity, as Cicero, in the "De Divinatione", says they did.

Ptolemy insists on the complexities of the celestial dispositions, on the manifold causes acting on the individual, and on the present imperfections of astrology. Predictions often fail because the science is immature, but frequent shipwrecks do not destroy the art of navigation. Ptolemy's frank admission of predictive failures contrasts with the bold statement by Diodoros that when the Chaldæans prophesied about kings they were always right.

Ptolemy repudiates impostors. He claims that the science has present value in spite of imperfections or failures, and that time will increase the value. Astrology is not useless because the stars decree inevitably : if they do cause a disease, a drug may cure it. Ptolemy manifests a recognizably scientific temper in handling a now discredited hypothesis.

Scientific inquiry is not incompatible with cosmic purposes, for Galen inquired how purposive Nature purposes. It is not incompatible with Providential ordering, for Galen inquired into the natural law through which God works, though the existence of God did not seem to him to be proved. If the stars do operate divine purposes, astrology can still have its operative scheme, as Galen had his attractive forces. A force radiated from the stars is central in early astrological doctrine—Cicero notes how the Chaldæans lodge it in the zodiac, Ptolemy speaks of the force diffused from the heavens on terrestrial things, and according to Galen "we receive the force of all the stars above". This force is variously affected by the sun, moon and planets according to their positions, conjunctions and relations to the signs of the zodiac. Other powers may co-operate, such as hot or cold, and an eye is often kept on the astrological agency of the air.

The moon is constantly prominent in the astrological versions. It has no more power than the other planets, Galen explains, but it is nearer. The Chaldæans, Cicero tells us, were careful to note the condition of the moon and its conjunctions with the stars at the moment of birth. The moon is usually peculiarly important in astrological theory, Thorndike notes, and more distant planets often act on the earth through it. It is quite reasonably, even if unjustifiably, suspected of inflicting genethlialogy, the science of nativities, upon many minds through many centuries.

The Chaldæan type of astrology is one hypothesis which marks the route of science. It seems to be an intelligible consequence of one phase in human thinking, and perhaps more so because man very earnestly wants to know what will happen.

PRE-NEANDERTHAL MAN IN THE CRIMEA

By SIR ARTHUR KEITH, F.R.S.

IN 1925 there appeared an annotation in *L'Anthropologie*[1] directing attention to the discoveries of ancient man and of his cultures then being made in the Crimea by G. A. Bonč-Osmolovskij, conservator of the Russian Museum in Leningrad. The chief site of these discoveries was the grotto or rock-shelter of Kiik-Koba, situated in the foothills of the Yaila Mountains, which run from Sebastopol towards the Kerch Straits. In the deepest and oldest stratum of the grotto were found fossil remains of part of a human skeleton ; these were reported to be Neanderthal in character ; they were examined by the late Dr. Marcelin Boule, who confirmed this diagnosis. The Crimea was then the most easterly point from which Neanderthal man had been reported. Students of early man were deeply interested in the discoveries reported by their Russian colleague and have eagerly awaited his full report—so far in vain. Recently my interest in Kiik-Koba was heightened by an article published in *Man* by Prof. Gordon Childe[2], in which the strata of the grotto are identified as similar in age and in sequence to those which yielded the fossil men of Mount Carmel—the subject of a report published by Dr. Theodore McCown and myself in 1939[3]. In February of the present year (1944) a pleasant surprise awaited me ; on opening a parcel bearing the Moscow postmark, I found within a volume entitled

—in the French translation kindly supplied by the author—"L'Homme fossile de la Grotte de Kiik-Koba (Crimée)". I found it to be Part 2 of the "Paleolit Kryma"*, published in Moscow in 1941. Part 1, which gives an account of the strata of the grotto and of their contents, was published in 1940. Inside the cover of the book which came to me so unexpectedly, the author has written an inscription in English; it is signed G. A. Bonč-Osmolovskij and dated December 10, 1942. Considering the obstacles which lay between the author and myself, the wonder is, not that the book took more than a year to reach me, but that it ever arrived.

As I came to know the contents of this book, which was made possible for me by the author's full résumé in French and by his supplying the numerous illustrations with legends in that language, I saw why we had had to wait so long for this report. Part 2 consists of 171 closely printed pages of Russian text, all of it devoted to one part of the Kiik-Kobian man—the hand. Men of the early Pleistocene are represented by specimens from Java, China, Heidelberg and Piltdown; the later Pleistocene has given us a score or more of fossil Neanthalians, all from Mousterian sites, but of the men of the middle Pleistocene we know very little. It was the realization of this blank in our knowledge that made the author resolve to squeeze every item of information from the fossil bones of the Kiik-Kobian hand to an extent that has never before been attempted. He had at his disposal only two bones of the carpus (trapezium, trapezoid); two of the ten metacarpi (those of the thumb and ring finger); and fourteen phalanges of the fingers. Some of the bones belong to the right hand and some to the left; by using mirror-images of the left bones he was able to incorporate them into a reconstruction of the Kiik-Kobian right hand. In the course of doing this he observed that those of the right were slightly the larger, pointing to right-handedness. To give his inferences a wide foundation, the author has extended his inquiries to the hands of modern man and of apes, and to the embryology of the hand of man and of apes; in short, he has constructed a new branch of inferential anatomy. He set out to give a description of a mid-Pleistocene European and ended by giving not only such a description but also what amounts to a treatise on the evolution of the human hand.

Kiik-Kobian man belongs to an age which precedes that which marks the appearance of Neanderthal man in Western Europe; he represents the folk of the upper or later Acheulean period of stone-culture. The only other site which had yielded fossil remains of Acheulean man, so far as M. Bonč-Osmolovskij could learn, was the Tabūn cave of Mount Carmel excavated (1929–34) by an expedition sent out by the British School of Archæology in Jerusalem and the American School of Prehistoric Research under the direction of Prof. Dorothy Garrod[4]. At Tabūn the superimposed cave deposits reached the enormous depth of 80 ft.; as at Kiik-Koba, the bottom stratum was of the remote palæolithic age known as Tayacian; in this ancient stratum Kiik-Kobian man had been buried—the oldest human grave known to us as yet. Over the bottom stratum, at Tabūn as at Kiik-Koba, come deposits of the later Acheulean, having a thickness of 16 ft. at Tabūn. Then, at Tabūn but not at Kiik-Koba, there follow strata—40 ft. of them—laid down during the period of Mousterian culture. The company of fossil Carmelites described by Dr. McCown and myself came from the deeper Mousterian layers. The Acheulean deposits yielded us only two fossil fragments—the greater part of the shaft of a femur and a worn lower molar tooth. We estimated the original length of the Tabūn femur, and from that gave the Tabūn Acheulean man a stature of 1·656 m. (5ft. 5in.); the Kiik-Kobian man is estimated (from the length of his tibia) to have been about 1·59 m. (5ft. 2·6in.). On comparing the femur and molar from the Acheulean deposits with the corresponding parts of the Mousterian Carmelites, we found a degree of correspondence that led us to regard the Acheuleans of Tabūn as probably ancestral to the Carmelites. The cultural evidence, however, is against our supposition, for Prof. Garrod noted a definite change in the type of stone implement on passing from the Acheulean to the Mousterian strata.

There was no femur, no molar tooth, found at Kiik-Koba with which we might compare our Tabūn specimens. When, however, we compare the Crimean hand-bones with those of the Mousterian Carmelites, we find them sharing in certain features which are also present in the hand-bones of Neanderthal man, but not in those of modern man. But in their massiveness and in their ruggedness the hand-bones of Kiik-Kobian man show a primitive characterization. He may well have been, as Bonč-Osmolovskij claims, ancestral to the Neanderthalians of Europe. Heidelberg man, who is known only by his lower jaw, has also a claim to be on the Neanderthalian ancestral line; a worn lower incisor, the only tooth found at Kiik-Koba, would be in place in a Heidelbergian mandible.

His painstaking methods have permitted M. Bonč-Osmolovskij to unfold a strange act of vandalism on the part of the Acheulean cave-men of Kiik-Koba. Not only had a man been buried in the bottom stratum, but also a child of about one year in age had been laid to rest near him, with its head directed towards his. Afterwards, for some unknown reason, the Acheuleans excavated and threw out that part of the floor of their cave which contained the graves, leaving *in situ* only the feet, right leg bones and parts of both hands of the man and those parts of the child which lie below the waist. Of the missing parts of the two individuals, only a worn lower incisor was recovered.

The author has my warm approval when he names this Crimean fossil type simply Kiik-Kobian man—*Homo kiik-kobiensis*. Future discoveries will reveal his exact place in the scheme of human evolution. But I doubt if my British colleagues will agree with him in the place he assigns to his fossil type in the scale of time. He places it, not in the last great interglacial period—the Riss-Würm—but towards the end of the preceding interglacial, the Mindel-Riss. Miss D. M. A. Bate[5] has reported on the fossil fauna from Tabūn; she found that the chief change took place, not at the end of the Acheulean period, but towards the end of the Mousterian. Consequently the Acheulean as well as the Mousterian cultures at Tabūn are regarded as lying in the Riss-Würm interglacial.

Bonč-Osmolovskij gives the Kiik-Kobian the short, thick and squat hand of a labouring man; he was a labourer who used stone tools. He quotes Engels to

* Paleolit Kryma. By G. A. Bonč-Osmolovskij. Vypusk 2: Kist' iskopaemogo cheloveka iz grota Kiik-Koba. (With a résumé in French.) Pp. 172+8 plates. (Moscow and Leningrad: Akademie Nauk SSSR, 1941.) 16.50 roubles.

the effect that "la main n'est pas seulement un organ de travail; elle en est aussi un produit". Our Carmelites also laboured with stone tools, but their hands had the shape and proportions still to be seen in native races. The author regards the squat, plate-like hand and foot which appear in the embryonic stage of man and ape as the original primate type; Kiik-Kobian man, he believes, has retained this type. He seeks to explain the retention of the primitive form of hand in man by supposing that man never was a tree climber, as his anthropoid cousins became, but that he was evolved in treeless surroundings, such as those which now exist in South Africa. He follows with a lively interest the history of the fossil South African anthropoids as it is being unfolded by Dr. Robert Broom and Prof. Raymond Dart, and expects to find support for his theory from that source. I, on the other hand, regard the embryonic hand of man and ape as representative of a structure which never had existence outside the womb; the embryonic hand depicts a stage in development, not in evolution. I seek to account for man's form of hand by supposing that even in the arboreal stage of his evolution, when he was a climbing animal, his lower extremities and feet were his chief means of support; his hands were never modified to form hooks, as in his hand-clinging anthropoid cousins[6].

My Russian colleague and I seem fated to construe prehistoric facts in a contrary manner. To him the fossil men of Java, of Peking, of Kiik-Koba, of Neanderthal, represent an ascending series which culminates, without a break, in *Homo sapiens*. For me, these pleistocene types represent separate evolutionary products, each being at a different stage of evolution. Bagehot showed a remarkable prescience when he declared (1869) that ancient races of mankind were "parish races". A transitional Neanderthal-Modern type has been discovered in Palestine but never in Europe. In Java, the early Pithecanthropoid is now linked to a later Australoid form by a series of fossil intermediates. The English contemporary of the Kiik-Kobians—the man whose skull was discovered deep in the Acheulean gravels at Swanscombe in the Thames valley by Mr. Alvan Marston in 1935[7], was not at all Kiik-Kobian in type. So far as his characters can be made out, they link him, not to the Neanderthalians, but to the earliest known fossil type in Britain—Piltdown man[8]. Our evidence as it now stands is very imperfect, but such as it is, it entitles us to assume that the British peninsula of Europe had, in earliest pleistocene times, its own type of humanity.

Although my interpretations clash with those of my Russian colleague at several points, that does not blind me to the fact that he has made a contribution to our knowledge of the highest importance; he has enriched our modes of anthropological inquiry, as well as our armoury of fact. Students of human evolution await the monographs which will complete his Kiik-Kobian studies with a lively interest.

[1] Keith, Sir A., "New Discoveries relating to the Antiquity of Man" (1931), 363.
[2] Childe, V. Gordon, *Man*, 98 (1942).
[3] McCown and Keith, "The Stone Age of Mount Carmel. The Fossil Human Remains from the Levalloiso-Mousterian", 2 (1939).
[4] Garrod, D. A. E., and Bate, D. M. A., "The Stone Age of Mount Carmel", 1 (1937).
[5] See under 4, p. 139.
[6] Keith, Sir A., *Amer. J. Phys. Anthrop.*, **26**, 251 (1940).
[7] Marston, Alvan T., *J. Roy. Anthrop. Inst.*, **67**, 339 (1937).
[8] Keith, Sir A., *J. Anat.*, **73**, 155 and 234 (1939).

OBITUARIES

Prof. L. R. Wilberforce

LIONEL ROBERT WILBERFORCE, eldest son of Edward Wilberforce, Master of the Supreme Court, and great-grandson of William Wilberforce, the emancipator, was born at Munich on April 18, 1861. After receiving his early education at the London International College, Isleworth, he became a foundation scholar of Trinity College, Cambridge. He graduated as thirteenth Wrangler and obtained a first class in the Natural Science Tripos.

In 1887 Wilberforce was appointed assistant demonstrator to Sir J. J. Thomson at Cambridge, becoming demonstrator in 1890 and University lecturer in physics in 1900. In the same year he succeeded Sir Oliver Lodge as professor of physics in the University of Liverpool, where he was at once faced with the planning of a new laboratory. This work was so well done that, except for limitations of space, it has satisfied most of the needs of present-day workers. It was in this laboratory that Barkla discovered the characteristic X-ray radiations of the elements. Some years previous to this, Wilberforce had suggested the now well-known method of investigating the polarization of X-rays, which in the able hands of Barkla provided the first real evidence of the undulatory nature of X-rays.

Judged by modern standards, the number of scientific papers published by Wilberforce is not large. His interests covered almost the whole range of classical physics. In his Cambridge days he wrote on surface tension, viscosity, the vibration of loaded spiral springs and miscellaneous electrical topics. A fascinating product of his work on springs is the comparatively little-known Wilberforce spring which admirably illustrates the periodic transfer of energy from translation to rotation. Wilberforce was a strong advocate of the kinematic design of instruments. His kinematic clamps and boss head, which he described in a lecture to the Physical Society in 1932, have given much satisfaction in many laboratories. In his later years, Wilberforce became interested in the subject of electrical units, and was in frequent correspondence with the late Sir Richard Glazebrook. Arising from this were two penetrating papers on magnetism in the *Proceedings of the Physical Society* of 1933 and 1934.

Wilberforce was an excellent teacher. He had a thorough understanding of all types of students. For the beginner he wrote, with Fitzpatrick, "A Laboratory Note Book of Elementary Practical Physics". That he had a clear perception of the difficulties involved in the teaching of physics is brought out in the interesting chapter he contributed to "A History of the Cavendish Laboratory". He took great pains to make physics attractive to his students. His lectures were almost lavishly illustrated with experiments, the demonstration of which gave him much delight. In describing physical phenomena—always in his own way—he seemed to prefer words to symbols. It is, however, as a popular lecturer that he will be most widely remembered. He devoted an extraordinary amount of time to the perfection of his lecture demonstrations. He was quite early in the field with an ingeniously constructed wave model and ripple tank which he exhibited on many occasions.

Wilberforce excelled as an administrator. His courtesy, ready wit, genial personality and clarity

of outlook were important factors in making him a most successful chairman of the many university committees on which he served. His work as acting vice-chancellor of the University of Liverpool for one session was much appreciated.

Wilberforce vacated the Lyon Jones chair of physics in 1935 in full vigour. He continued to serve on the committee of the Liverpool Maternity Hospital, of which he had been vice-president for more than twenty years, and on the committee of the Liverpool Radium Institute, besides taking an active interest in church work.

No account of Wilberforce would be complete without reference to his mountaineering activities and his great skill as a skater, which he maintained almost to the time of his death in his eighty-third year. R. W. ROBERTS.

Sir Thomas Ranken Lyle, F.R.S.

FORMER students of the University of Melbourne in all parts of the world will be sorry at the death in Melbourne of Sir Thomas Ranken Lyle, at the age of eighty-three. Lyle came from Dublin, after an academic career of distinction (enhanced by three years of playing Rugby for Ireland), to the Melbourne chair of natural philosophy in 1889, when the University was in its thirty-sixth year and he in his thirtieth; he held the professorship for more than a quarter-century, and thereafter continued to give valuable services to the State of Victoria until a few years ago.

In the school of physics Lyle had at first much to build up—though on a sound foundation—and he very soon became one of the vigorous group of young professors who in the ensuing years did great work in advancing the University both internally and by reputation. Lyle's direct contributions to physics, especially in the principles of current generation in dynamos, were recognized in 1912 by the fellowship of the Royal Society. His knighthood came in 1922.

In the more elementary parts of his teaching, to students of engineering and medicine as well as science, Lyle imparted even to backward members of a class solid realities and conceptions which endured. For the better students, and in senior work, he laid very fine foundations indeed. No one who was in Lyle's classes could forget his firm good-humour, his benign tolerance of the mathematical weakling. He himself was a strong mathematician, though his first-year men—confusing arithmetic with mathematics—were apt to watch hopefully for the contest for the right result between any of his admirable lecture-bench experiments and his impatient manipulation of a Fuller's slide-rule in working them out. As befitted a good experimenter, any error was always debited to the slide rule. But no student took liberties with Lyle; they all felt too much respect and affection towards him for that. He did not seek this; he received it. His strong and honourable common sense, his shrewdness that stooped to nothing petty, the reserves of his judgment and its cogency when he did give it utterance, helped to make him a force in the whole University and, coupled with a geniality brought from his native land, made him a friend for life of its other best men.

Retiring fairly early from his chair, Lyle was called upon to give advice to the State on educational questions and, especially, on large technical developments: first as chairman of the Electricity Commission of Victoria and then for nearly twenty years more a member, he did very important public work which, with his impress on the University, has had effects which will endure.

Lyle married Clare Millear in 1892; and their family have made high places of their own in Australian affairs. J. I. O. MASSON.

Mr. S. E. Winbolt

ARCHÆOLOGY has lost a keen worker by the death, at the age of seventy-six, of Samuel Edward Winbolt. Educated at Christ's Hospital and at Corpus Christi College, Oxford, where he took high classical honours, he returned to Christ's Hospital as a master. There he published some educational editions of the classics and other works on history and English literature. His classical training turned his attention naturally to Roman and kindred archæology, to which he devoted himself upon his retirement.

Winbolt's most important work was the excavation of the large Roman villa at Folkestone, published in book form, "Roman Folkestone", in 1925; the smaller villa at Southwick, Sussex, owned by the Sussex Archæological Trust; the posting stations on Stane Street and other detailed investigations upon this Roman road, published recently in "With a Spade on Stane Street", which will be the standard authority on this road; a series of camps of the Early Iron Age in the Weald ranging from Tonbridge to Hascombe; and the rediscovery of the sites of the important local medieval glass industry at Chiddingfold, near Horsham, published in book form, "Wealden Glass" (Combridge, Hove), in 1933.

Winbolt contributed the Romano-British portion, an important collection of material of the volume on Sussex, in the Victoria County History. He prepared some attractive guides for Bell's county series, including Sussex, Kent, Devon, Somerset and others. He had a gift for the popular exposition of archæology and one of his last works was a Pelican book on prehistoric Britain, "Britain B.C.". A most helpful correspondent, he had great charm of manner, and the important knack of encouraging beginners and young helpers in archæology. I. D. MARGARY.

Prof. L. S. Palmer

PROF. L. S. PALMER, chief in the Division of Agricultural Biochemistry of the Department of Agriculture at the University of Minnesota, died on March 8 at the age of fifty-six. Dr. Palmer had been at the University of Minnesota since 1919 and became head of the division at University Farm a year ago, succeeding the late Dr. Ross A. Gortner. More than thirty years of research and teaching at the Universities of Missouri and Minnesota had earned for him wide recognition as a chemist, especially in the field of dairy science and nutrition. He was the first recipient of the Borden Award for outstanding research in the chemistry of milk.

While Dr. Palmer's investigations carried him into many of the broad phases of nutrition and vitamin values, his principal interest was in such fields as the pigments of milk and butter, the cause of butter defects and storage troubles, the physical and colloid chemistry of milk and the churning process. He carried out extensive research in animal nutrition, with stress on the mineral needs of dairy cattle and the relation of feeding to dairy production and quality.

NEWS and VIEWS

Science and Research in Great Britain

THE debate which took place in the House of Commons on April 19 on Sir Granville Gibson's motion urging "the declaration of a bold and generous Government policy of financial assistance directed to the expansion of teaching and research facilities in our universities and technical colleges, to the extension of pure and applied research in all fields by the State, by industry through private firms and research associations and to the effective and rapid application of the results of research", in connexion with which the White Paper on Scientific Research and Development (Cmd. 6514) had been issued, covered much of the ground of recent reports of the Parliamentary and Scientific Committee and other bodies, as well as the recent lectures on science and industry arranged by the Manchester Chamber of Commerce. Sir Granville said that in regard to the research associations the Government grant has not increased in proportion with the increase in contributions from industry. An increase in expenditure on research of anything up to £15,000,000 would be a valuable investment for the country's future. Like Mr. Edmund Harvey and others who followed, Sir Granville pointed out that the staffs of the research and scientific departments of the colleges of Great Britain are far too small, and Mr. Salt, who followed him, urged that the number of research workers should be doubled. On particular fields of research, Mr. Salt instanced coal research as specially important; Sir Ernest Shepperson stressed the need for agricultural research, particularly in relation to nutrition, and was supported by Mr. R. C. Morrison, Dr. Haden Guest and Major York, as well as by Mr. Snadden, who referred especially to veterinary research; Sir John Graham Kerr referred to fisheries research, while Mr. Owen Evans and Mr. James Griffiths directed attention to the neglect of geological research and surveys. Sir George Schuster said that more attention should be given to our failure to make full use of the knowledge gained from the limited research carried out, and urged that, first, a more scientific frame of mind must be created in British industry; secondly, closer contact should be established between those engaged in pure scientific research and those concerned with its practical applications; and thirdly, means should be found to assist the development stage and the practical evolution of new industrial ideas.

The Lord President of the Council, Mr. Attlee, replying on the debate, said that the amendment was in full accord with the policy which the Government is following now and which it desires should be followed in the post-war period. The Government is fully alive to the fact that the winning of the peace will depend largely on a full and right use of scientific men and organizations. Assistance will be given in a bold policy, and the Government will take a lead, but it must be backed by a readiness to use the results of that research and by public opinion. The nation must become more aware of the importance of science. We shall be utilizing scientific methods throughout our activities of Government and of industry, and industry must be ready to take advantage of the new openings which the application of scientific research affords. The Government is also examining the need for the establishment of a fund to meet the cost of developing new inventions and of providing facilities for testing new ideas for industry, as well as how best to fit this in with the work of the co-operative research associations. The Government is also entirely in favour of generous support for the extension of teaching and research in the universities of Britain, but Mr. Attlee questioned the practicability of any statutory university advisory council. Mr. Attlee, welcoming references in the debate to the remuneration of scientific workers, said that the whole question of the relative remuneration of scientific workers in Government service is under investigation and steps have already been taken to raise the remuneration of the heads of research institutions. He thought a Ministry of Science would be a great mistake: what we need is to see that there are persons in all departments who are trained in the scientific method and appreciate what it means. Finally, he referred to the considerable improvement in the machinery of government through the creation of a Central Statistical Section and a Central Economic Section. He welcomed the debate as promoting the formation of an informed public opinion which would support a sustained effort.

Control of German Chemical Industry

IN the House of Lords on April 18, Lord Vansittart raised the question of the control of German chemical industry after the War. In particular, he asked for the appointment of a committee of scientific men to prepare a suitable scheme for the control or elimination of Germany's nitrate and hydrogenation plants. Such control might involve a close watch on German scientific education and research, and even the limitation of manufacture of certain high-precision instruments. There will be general agreement with his view that scientific men are best able to devise means to achieve such restriction and control. Lord Vansittart was supported by Lord Horder, who mentioned two synthetic drugs, used in the treating of sleeping sickness and malaria respectively, the supply of which had been deliberately restricted in countries outside Germany as a part of the Nazi preparation for total warfare. Lord Strabolgi and Lord Farringdon sounded a note of caution, pointing out that to cut down German nitrate production unduly would have a harmful effect on European agriculture and would in the end impede the work of re-establishing the health of the people.

The Government reply was given by Lord Cherwell, Paymaster-General. He said that various committees have been considering the questions involved, and the Government intends not only to call in more expert advice but also to give great attention to the recommendations made. He agreed that to prevent Germany from manufacturing nitrate and ammonia would create difficulty in supplying Central Europe with fertilizers, but German research will have to be supervised. The question of the control of German chemical industry is part of the much larger question of curbing the German war potential, and the Government is prepared to take every step possible to achieve this end.

It is indeed welcome news that the Government has this matter under consideration, and that scientific workers, whose special competence in this field is obvious, are to take a prominent part in formulating policy. It will be recalled that the matter was raised by Sir Robert Robinson so long ago as early in 1943, at the annual luncheon of the Parliamentary and Scientific Committee, and some of the problems involved have been discussed in these columns (see

NATURE, 151, 455 and 562; 1943). No time should be lost in bringing together those with the widest knowledge of the chemical, engineering and industrial problems involved, in order that a practicable scheme of control may be ready for operation as soon as hostilities cease.

Science and Industry at Manchester

IN presiding at the last of the series of meetings on "Science and Industry", arranged by the Manchester Chamber of Commerce, on April 20, the president, Mr. A. H. S. Hinchliffe, stated that to give continuity to the interest stimulated by the meetings and improve the liaison between scientific workers engaged on research and the industrial and commercial world, the Chamber has been discussing with the University of Manchester the formation of a joint standing council the members of which would be nominated by the University and the Chamber. The Cotton Industry Research Association is to be invited to take part in the work of the proposed council, which is intended to be an advisory and consultative body. While its precise functions cannot yet be defined, it is hoped that the results of research work would be constructively examined and discussed and the workers benefited by access to the experience of firms in the area. At the same time, business people would be assisted in their quest for new knowledge and in the solution of difficulties. It might even be possible to establish a bureau of information, and the range of subjects open for discussion in the council would cover economics and sociology as well as technical matters. The council's aim should be to stimulate an advance of thought and encourage enterprising action, primarily in the North-Western area but, it was hoped, also in a much wider sphere. Sir E. Raymond Streat urged, in supporting the proposal, that if, in the coming age of research, we could weave the life and work of the University of Manchester into the life and work of the great industrial area and commercial centre which surrounds the University, we might produce a great vitalizing force. The interest evoked by the meetings shows that people holding responsible positions in industry and commerce in Lancashire realize that only by a fertile marriage between science and industry can we establish and maintain the margin of superiority essential for post-war prosperity. He suggested three main objectives: to be first with new inventions and discoveries and promptest in their application; to be quickest and surest in diagnosis of economic and technical trends; and to be foremost in economizing costs so as to be more competitive without lowering wages. The age of research does not imply disaster for all small firms, though their managers will need much fuller scientific and technical attainments than was customary in the past.

Fundamental Scientific Research and the State

SIR EDWARD APPLETON'S final address in the Manchester series dealt with "Fundamental Scientific Research and its Practical Importance". Sir Edward said that he believes it is still necessary to insist that there is no barrier between so-called pure and applied research. There is great danger that the general public should regard the scientific man as one whose sole task is to produce a succession of discoveries of immediate use to industry, or of direct use to the individual member of the community. The main theme of his address was the wisdom of ensuring that there should continue to be in Great Britain many active research groups the scientific work of which would be that of free inquiry and the extension of man's knowledge of Nature, without concern as to whether the final results are of practical use to humanity or not. Emphasizing and illustrating the way in which most of the scientific developments of the present century had their origin in purely scientific work conducted with no thought of utility, Sir Edward pointed out that we also owe to workers in the field of pure science the scientific method of inquiry by observation, experiment and theory. It is, of course, also important that there should be practical men eager to test the properties of the new compounds and materials, and that applied scientists should keep themselves constantly in touch with the development of new knowledge, so that the gap between discovery and its application may be bridged as quickly as possible.

With regard to the conditions of success in fundamental research, chance often plays an important part. Fundamental research flourishes most abundantly in an atmosphere of freedom and, accordingly, Sir Edward believes we must look to our universities for the main body of our fundamental research. We must also recognize the importance of the man of exceptional originality and imagination, and see that he is supplied with the facilities he needs. Industrial research organizations and Government research departments should also contribute to the general body of fundamental knowledge, and he believes it to be the function of the Agricultural Research Council, the Department of Scientific and Industrial Research and the Medical Research Council to pursue fundamental research in fields which are ultimately likely to be of practical benefit to the community. Both Government and industry are awakening to the importance of scientific research and the need for its extension and application, but the large post-war developments in industrial research and technology must be sustained by an adequate volume of fundamental research.

United Nations Educational Reconstruction Plans

A TENTATIVE draft constitution for a United Nations Organization for Educational and Cultural Reconstruction was accepted by the Conference of Allied Ministers of Education at a meeting on April 19. If adopted by the Allied and Associated Governments, it will permit joint efforts in this field in line with parallel work already being developed by the Food Conference and the United Nations Relief and Rehabilitation Administration. The projected Organization would direct its activities at first to the emergency work of restoring the educational systems and the cultural institutions destroyed by the Axis Powers. Experience gained in carrying out these emergency tasks would create a basis for lasting international co-operation in educational and cultural fields. The proposed constitution was drafted at two open meetings convened by the Conference of Allied Ministers of Education and the American Education Delegation, led by Congressman Fulbright, which came to London early this month to work out plans for American collaboration with the Conference. The meetings were attended by representatives of all member and observer States currently interested in the Conference and were presided over by Mr. Fulbright. The device of holding open meetings enabled all representatives

present to participate fully, equally and without prejudice to their positions in the Conference.

The text of the tentative draft constitution for the proposed Organization consists of seven sections. It opens with a statement of the underlying reasons why international co-operation in educational reconstruction should be attempted. The functions of the projected Organization are then defined in terms which should permit it to work effectively in the fields of educational and cultural rehabilitation and reconstruction, and to develop ultimately into a permanent body with broader activities. Membership is to be open to all the United Nations and Associated Nations and to such other nations as shall be accepted by the assembly, upon application thereto, after the cessation of hostilities with the Axis Powers. Provision is made for an assembly with equal representation and votes for all member States, an executive board to be elected by the assembly and an international secretariat. The financial section states that administrative expenses shall be shared by the member nations on a basis to be agreed by the assembly. It also provides for the creation of an Emergency Rehabilitation Fund controlled by a committee, which will fix contributions and also make allocations from the Fund. The committee will consist of representatives of the three States making the largest contributions for administrative expenses and three members elected by the executive board. Member nations would be required to supply information about education and cultural matters. Provision is also made for defining the legal status of the Organization and its staff, providing for co-operation between the Organization and existing international organizations in the educational and cultural fields, and governing the relationship of the Organization to any agency for co-ordinating public international organizations.

Clinical Use of Penicillin

THE issue of the *British Medical Journal* dated April 15 includes eight papers which record the results of work done at one of the four main centres established in March 1943 by the Penicillin Clinical Trials Committee of the Medical Research Council. A leading article comments on these papers and on other work in the United States, where much larger supplies of penicillin are available, so that work on a larger scale is possible. In the first article, Prof. L. P. Garrod and Dr. Christie describe the work and policy of the centre at which all this work was done. Other articles deal with the systemic administration of penicillin by continuous intravenous drip, intramuscular injection, drip transfusion into the bone marrow of the sternum and continuous intramuscular drip transfusion; with the effects of penicillin on infections of the mandible and of bone, the latter indicating that treatment of chronic bone infections is not yet satisfactory; with its use as a local application to lesions of soft tissues (wounds, abscesses, cellulitis and infected skin eruptions); and its effects on breast abscess and certain skin diseases.

A final article by Prof. Garrod explains the extensive laboratory work which is necessary if the clinical work is to be properly controlled. Penicillin is supplied in the form of a powder or tablets and solutions have to be made from these. Because penicillin is a very labile substance, and because many bacteria are quite unaffected by it and may, therefore, live in these solutions or even decompose them so that they lose their activity, the greatest care is necessary in making up the solutions. Further, it is advisable to determine, before treatment, what micro-organism is being treated and the sensitivity of the particular strain concerned, because certain strains of some kinds of bacteria (especially Staphylococcus) vary in their resistance to penicillin. It is also necessary to obtain swabs from the patients to check by *in vitro* methods the effects of treatment. Because the therapeutic effect depends on keeping up a sufficient concentration of penicillin in the lesion, the concentration actually being maintained must be ascertained from samples taken from the patient. Estimations of the penicillin content of the blood are also done.

It will do no harm, perhaps, to repeat Prof. Garrod's reminder that it is of the first importance to realize that penicillin acts only on certain bacteria, most of which are Gram-positive, the chief exceptions being the gonococcus and meningococcus; and that certain bacteria are highly resistant to it. On the other hand, it has, he says, enormous antiseptic power, is almost completely indifferent to the medium in which it acts and almost completely non-toxic to the body as a whole. Clearly everything possible is being done in Great Britain and elsewhere to apply this remarkable antibacterial substance to the relief of suffering in man and animals. Those who impatiently demand quicker progress are evidently unaware of the great difficulties involved, and are often incapable of assessing the scientific care required, or the dangers of drawing premature conclusions from the extensive experimental work that is being done.

Warrington Yorke Memorial Fund

THE death of Prof. Warrington Yorke, tragically unexpected by those who knew his vigour and force of character, was a great loss to the Liverpool School of Tropical Medicine and to medicine and biology. His work on the trypanosomes, the nematodes and on other parasitic and tropical diseases earned for him an international reputation, and his later work on the chemotherapy of parasitic diseases was of equal value. It is said of him (*Brit. Med. J.*, April 15) that his introduction of drugs of the diamidine series is making it possible to master kala-azar in places where it is resistant to compounds of antimony, and tribute is paid to his efforts to place British chemotherapy in the front rank. Not only the former colleagues and friends of Warrington Yorke, but also all who respect and admire scientific ability and devoted effort to apply it to the relief of human and animal suffering, will like to know that their admiration may take a practical form. The Council of the Liverpool School of Tropical Medicine is appealing for funds to establish the Chemotherapeutic Research Department of that School as a fitting memorial to Warrington Yorke, who started the work now going on in it. Subscriptions may be sent to the Hon. Treasurer, Warrington Yorke Memorial Fund, Chamber of Commerce, 1 Old Hall Street, Liverpool.

Tattersall Memorial Fund

PAST and present students of the Department of Zoology, University College, Cardiff, have opened a Tattersall Memorial Fund, the object of which is to found a studentship in zoology in the College as a memorial to the late Prof. W. M. Tattersall, who died on October 5, 1943. The organizers of the Fund also desire to invite the many friends of Prof. Tattersall, particularly zoologists, in various parts of the world, to join them in perpetuating his memory.

Information may be had from Mr. G. E. H. Foxon, who is acting as the honorary secretary and treasurer of the Fund, at the Department of Zoology, University College, Newport Road, Cardiff, and to whom donations should be sent.

Earthquakes Registered at Fiji

THE first seismological bulletin has been received from the acting director of the Meteorological Office at Suva (Dr. W. Ralph Dyer). At this station a Milne-Shaw horizontal seismograph has been set up to register north-south movements, the co-ordinates of the station being latitude 18° 08′ 56″ south, longitude 178° 27′ 26″ east. The first earthquake to be recorded officially at this station occurred on July 31, 1943. Thirty earthquakes were registered in August, and up to September 21 twenty-two earthquakes were registered during September. On September 21 the seismograph was temporarily out of action owing to delays in the supply of photographic paper. The initiation of this new station is warmly welcomed. The attention of the Seismological Committee of the British Association for the Advancement of Science to this matter has been mentioned previously in the columns of NATURE, and the new station is also receiving assistance from the Dominion Observatory at Wellington, New Zealand. The Fiji Seismological Station is in an excellent position for the recording of the frequent earthquakes and tremors, a large number of which are submarine, in that Pacific region.

Town and Country Planning Association

THE Town and Country Planning Association will move to the Planning Centre, 28 King Street, Covent Garden, London, W.C.2 on May 8. The new premises provide a room for public meetings (including the Association's fortnightly lunch-time meetings), space for exhibitions and film shows and a meeting room for the Association's members and guests. The Association's library service will be greatly extended and an information service will be made available to deal with all aspects of town and country planning. The Association has arranged an exhibition "The English Town: its Continuity and Development", which is being taken to various parts of England during the next few months, and also an exhibition and film "When We Build Again".

Comet Schaumasse

PROF. H. SHAPLEY reports a telegram received from Strömgren and Lundmark announcing the rediscovery of this comet on March 30. The elements of its orbit and an ephemeris are given in the "Handbook of the British Astronomical Association", 1944. Perihelion passage took place about November 27.

Research into Problems of Hearing and Deafness

BY arrangement with the Medical Research Council, an Otological Research Unit has been established at the National Hospital for Nervous Diseases, Queen Square, London, W.C.1. It is to be maintained jointly by the Council and the Hospital, as in the case of the existing Neurological Research Unit. The director is Dr. C. S. Hallpike, a whole-time member of the Council's scientific staff and aural physician to the Hospital. The Medical Research Council, also, has appointed three new committees to advise and assist in promoting a general programme of research work into problems of deafness. They will deal with the following divisions of the subject. (*a*) Medical and surgical problems of the causation, prevention and treatment of deafness (chairman: Prof. H. Cohen, University of Liverpool). (*b*) Electro-acoustical problems relating to the design and application of instruments used in the investigation and alleviation of deafness (chairman: Dr. W. G. Radley, Post Office Research Station). (*c*) Problems relating to the educational treatment of deafness in children and adults (chairman: Prof. F. C. Bartlett, University of Cambridge). The membership of the committees includes nominees of Government departments and various bodies concerned with the practical questions which are involved.

Birds of Ceylon

MR. P. DERANIYAGALA, director of the National Museums of Ceylon, writes, pointing out that in the obituary notice of Hugh Whistler appearing in NATURE of August 21, 1943, no reference is made to his last major work, the avifaunal survey of Ceylon by the British and Colombo Museums. Whistler worked out the collections, and the results are now being printed in the Colombo Museum journal, *Spolia Zeylanica*; they should be published by about May.

The Night Sky in May

FULL moon occurs on May 8d. 07h. 28m. U.T., and new moon on May 22d. 06h. 12m. The following conjunctions with the moon take place: May 20d. 13h., Mercury 2° N.; May 24d. 04h., Saturn 2° N.; May 27d. 01h., Mars 1° N.; May 28d. 10h., Jupiter 1° S. There is only one occultation during May, and that is of 56 Gemi. on May 25d. 21h. 00·1m. (*D*). Mercury is in inferior conjunction on May 2 and is stationary on May 14. The planet rises about the time of sunrise in the middle of the month and forty minutes before sunrise on May 31. Venus, rising shortly before the sun throughout May, is not very well placed for observation. Mars moves from the constellation of Gemini into Cancer about the middle of May and is visible during the early part of the night. On May 1 the planet sets at 1h. and on May 31 at 23h. 48m. Jupiter is in the constellation of Leo and sets at 2h. 10m. and 0h. 19m. at the beginning and end of May. Saturn, in the constellation of Taurus, is drawing near the sun and sets at 23h. and 21h. 19m. at the beginning and end of the month. The η Aquarids are active during May 1–6 and can be seen in the early morning hours. The radiant is close to R.A. 22h. Dec. −2°.

Announcements

SIR JOHN MARSHALL, formerly director-general of archæology in India, has been awarded the Gold Medal of the Royal Asiatic Society.

PROF. W. N. HAWORTH, professor of chemistry in the University of Birmingham, has been elected president of the Chemical Society.

THE Committee on Nutrition Surveys, set up by the English Group of the Nutrition Society, a year ago, has drawn up a list of investigations, recent or in progress, into: (*a*) Consumption of Food; (*b*) Nutritional State; and (*c*) Effect of Supplements on Health and Efficiency. The number is unexpectedly large. A list of these investigations will be sent to anyone working on the subjects, on application to the director, Prof. J. R. Marrack, Advisory Committee on Nutrition Surveys, Bureau of Nutrition Surveys, London Hospital, E.1.

LETTERS TO THE EDITORS

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

The Osmotic Balance

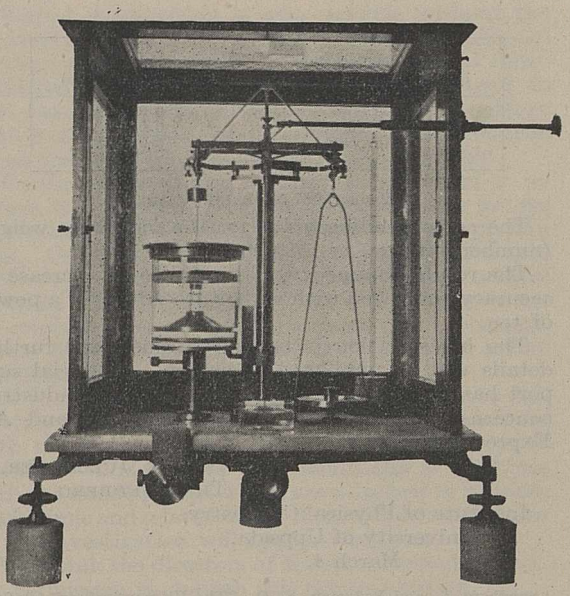
In the case of polydisperse high polymers, different methods of molecular weight determination give different kinds of average values[1]. The two most important absolute methods are ultra-centrifuging and measurement of osmotic pressure. In the first case one gets, according to the method of calculation used, either weight averages or so-called z-averages, while osmotic pressure measurement always gives number-averages. The knowledge of several different average values for one substance helps us to judge the degree of polydispersity. When dealing with thread-like molecules of high molecular weight, the osmotic measurements are rendered difficult partly by the fact that even comparatively dilute solutions of this type possess high viscosity, partly owing to breakdown of the ideal gas laws at experimentally usable concentrations. One therefore has to resort to a suitable extrapolation procedure for obtaining correct zero-concentration pressure values. These circumstances make it necessary to perform the osmotic measurements at as low concentrations as are experimentally possible.

The methods so far used have aimed at determining the position of a liquid meniscus in a capillary, either by measuring the height of a column at equilibrium[2,3,4], or by applying a variable counter-pressure against the meniscus and measuring its rate of migration at different values of the counter-pressure[5,6].

In order to make it possible to determine lower osmotic pressures than the above-mentioned procedures allow, we have constructed an osmometer, in which the liquid passing through the membrane is weighed. It can be used for osmotic pressures from a few centimetres of water pressure and downwards to some hundredths of a centimetre.

In an undamped analytical balance one of the scales is removed, and on the floor of the balance case is fixed a stand with an adjustable platform carrying a glass cylinder filled with solvent. The osmotic cell is constructed of aluminium and glass, the necessary cementings being made with lead-oxide-glycerine. The lower part of the cell is conical with a basal diameter of 5 cm. At the apex is fixed a glass tube a few centimetres in length and of 0·9 cm. inner diameter. The upper part of the glass tube has an aluminium collar, carrying a wire so that the cell can be hung on the balance arm. A semi-permeable membrane is attached to the base of the conical recipient by means of a threaded ring and a perforated membrane-support. The membrane itself acts as packing material against leakage. The osmotic cell and part of the glass tube is filled with solution and suspended on the balance in such a way that it dips into the solvent contained in the glass cylinder. The whole apparatus is placed in a constant-temperature room.

By means of the adjustable platform the difference in level between the solution in the cell and the solvent in the glass cylinder can be varied. The balance is adjusted to neutral equilibrium. When the weight of the cell increases, the cell sinks until the buoyancy compensates the increased weight. Because of the minuteness of the displacements, the reading of the balance is magnified by means of a beam of light, doubly reflected from a mirror fixed to the balance.



THE OSMOTIC BALANCE.

In order to prevent evaporation, the glass cylinder is provided with a suitable lid perforated in the middle to admit the suspension wire. An open dish with solvent placed inside the balance case delivers solvent vapour to the air, thus diminishing evaporation losses. The creeping of the solvent along the inner wall of the cylinder is prevented by a collar fixed to this wall and filled with solvent. Electrostatic effects, which would disturb the weighing, are eliminated by means of a metal netting placed on the bottom of the cylinder and connected to the lid and to the cell through the suspending wire.

Experiments with the above apparatus have been carried out on nitrocellulose dissolved in butyl acetate. As semi-permeable membrane, 'Ultracellafilter' was used. It takes a considerable time for osmotic equilibrium to be reached and, therefore, a compensation procedure, involving the measurement of the velocity of migration of solvent through the membrane at different levels in the osmometer, was adopted. The osmotic pressure is found by interpolation.

As reference point for the measurement of the difference in levels between solution and solvent is taken the position when the meniscus in the cell is in line with the meniscus in the cylinder. Different adjustments of this position are reproducible to 0·01–0·02 mm. From this starting position all level differences are calculated by means of the corresponding weight differences.

It is necessary to introduce a correction for the rise of the solution owing to surface tension. This is done through null-experiments with solvent both inside and outside the cell.

The following example demonstrates the accuracy obtained so far. The nitrocellulose used as test material was made from American linters and had a nitrogen content of 12·28 per cent. The solvent used was normal butyl acetate, temperature 25° C. The correction for capillary rise was found to be 0·028 and 0·029 cm. in two null-experiments.

Concentration (gm. per 100 gm. solution)	Osmotic pressure (cm. butyl acetate)
0·0501	0·089
0·0500	0·084
0·0500	0·087

Mean, 0·087 cm. butyl acetate.

The corresponding value for the molecular weight (number-average) is 148,000.

The result obtained would indicate an increase in accuracy compared with earlier procedures of a power of ten.

The investigation is being continued and further details will be published elsewhere. Financial support has been received from the following industrial concerns: AB Bofors, Nitroglycerin AB and AB Expressdynamit.

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March 4.

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Organic and Inorganic Pyrophosphates as Shock-inducing Agents

IT was shown by Green[1] and Bielschowsky and Green[2] that injection of the sodium salts of adenosine triphosphate, obtained from Dyckerhoff's "myotoxin", into a variety of animals resulted in a shock-like syndrome. It was suggested that the pyrophosphate group might be responsible for at least some of the described effects.

Further investigations on the striated muscle product show that its adenosine triphosphate is present in the form of the magnesium salt.

It seemed important to analyse the shock-producing action of adenosine triphosphate by a comparison of the action of related compounds varying in the three components: adenosine – polyphosphoric acid – magnesium.

As to the polyphosphoric acid, a detailed study has shown that the injection of $Na_4P_2O_7 . 10H_2O$ does produce effects similar, in some respects at least, to those produced by adenosine triphosphate. To study the influence of the adenosine and magnesium in the molecule, solutions of the sodium and magnesium salts of adenosine triphosphate and inosine triphosphate were tested for their lethal and shock-producing potencies in the rat and mouse, and for their depressor activities in the cat. Both salt solutions were prepared from the corresponding barium salts (barium inosine triphosphate from barium adenosine triphosphate by deamination with sodium nitrite), avoiding excess of magnesium, and their concentrations were checked by estimations of nitrogen and 7 min. phosphorus.

A condensed summary of the results of the assays is given in Table 1, and some abstracted data showing a few of the effects in the whole animal are given in Table 2.

In both the mouse and rat, the lethal doses of the inosine compounds were significantly higher than those of the corresponding adenosine compounds. Some of the shock-inducing effects of the adenosine triphosphate salts are therefore presumably associated with the presence of the amino group of adenosine.

The findings with the sodium salts show that their lethal doses were significantly higher in terms of their pyrophosphate contents than that of sodium pyrophosphate, with the exception of sodium adenosine triphosphate in the mouse. The interpretation of these results is complicated by the fact that the lethal dose of sodium pyrophosphate in the mouse was more than twice that in the rat. In both species the influence of the amino group in the sodium adenosine triphos-

TABLE 1. INTRAPERITONEAL LETHAL AND INTRAVENOUS DEPRESSOR DOSES OF POLYPHOSPHATES (GROUPS OF 6–12 RATS AND 8–16 MICE).

Compound	Mouse			Rat			Cat
	LD_{100} (mgm./ 100 gm. body wt.)	P_2O_7 content (mgm.)	P_2O_7 / P_2O_7—Mag.aden.triphos.	LD_{100} (mgm./ 100 gm. body wt.)	P_2O_7 content (mgm.)	P_2O_7 / P_2O_7—Mag.aden.triphos.	Depressor dose: 30 mm. Hg./kilo body wt. (mgm.)
Magnesium adenosine triphosphate	45	14	1	50	16	1	0·2
Magnesium inosine triphosphate	60	19	1·4	70	22	1·4	4·00
Striated muscle product*	300	26	1·9	340	29	1·9	0·7
Sodium adenosine triphosphate	130	38	2·7	100	29	1·8	0·35
Sodium inosine triphosphate	240	70	5·0	120	35	2·2	—
$Na_4P_2O_7 . 10 H_2O$	120	47	3·4	50	20	1·3	†

* Crude muscle product similar to those from which adenosine triphosphate salts were derived.
† No depressor action except in enormous dosage.

TABLE 2. GENERAL EFFECTS OF MINIMAL LETHAL DOSES OF ADENOSINE AND INOSINE TRIPHOSPHATE IN THE RAT. (AVERAGE OF 4 RATS.)

Compound	Hb (Haldane) per cent Hours 0	1	4½	Rectal temp. (° C.) Hours 0	1	4½	Respirations per min. Hours 0	1	4½	No. surviving at 4½ hr.
Magnesium adenosine triphosphate	96	110	140	37	25	21	94	51	16	1
Magnesium inosine triphosphate	91	113	122	36	28	26	94	68	70	4
Striated muscle product	102	112	116	36	28	29	103	73	76	4
$Na_4P_2O_7$	93	119	144	37	28	29	93	60	72	2

phate is evident. Nevertheless, the polyphosphoric acid seems to be an important factor since, for example, the lethal dose of muscle adenylic acid is much higher than that of adenosine triphosphate.

The replacement of sodium by magnesium in inosine triphosphate much more than compensates for the loss in activity produced by the substitution of the NH_2 group in the adenosine triphosphate by the OH group (inosine triphosphate). This is shown by comparison of the results obtained with magnesium inosine triphosphate and the sodium salts of adenosine triphosphate and inosine triphosphate (Table 1).

It may be assumed, therefore, that the P_2O_7 group becomes biologically more active, at any rate so far as its shock-producing effects are concerned, when it is combined with both magnesium and either adenylic or inosinic acids. As we have been unable so far to prepare an inorganic magnesium polyphosphate suitable for injection, we do not yet know whether this is due to the influence of the magnesium ion on the polyphosphoric acid group.

The magnesium salt of adenosine triphosphate had the greatest potency of all the substances tested, and using minimal lethal doses a shock-like condition followed the injection much more rapidly (Table 2). It is noteworthy that the quotient P_2O_7/P_2O_7—magnesium adenosine triphosphate is the same in both species for magnesium adenosine triphosphate, magnesium inosine triphosphate and the striated muscle product (Table 1), whereas there is a considerable difference between the rat and mouse in the quotients for both sodium adenosine triphosphate and sodium inosine triphosphate. A calculation on the basis that all the adenosine triphosphate in the striated muscle product is present as the magnesium salt accounts fully for its vaso-depressor activity (see Table 1). Its lower shock-producing potency after intraperitoneal injection is probably due to a slower rate of absorption of the magnesium adenosine triphosphate from the crude muscle product. All the data at our disposal make it highly probable that the adenosine triphosphate in striated muscle is present in the form of the magnesium salt. This conception is in good agreement with the results obtained by Szent-Györgyi and his collaborators[3].

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March 21.

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Reaction between Proteins and Formaldehyde

IT has been found possible to deamide animal and plant caseins by treatment with a solution of 1 per cent caustic soda for 40 hr. at 45° C. The desamido casein, when hardened with formaldehyde under neutral conditions, combines with the same amount of formaldehyde as does the untreated casein. In the presence of salts, acids (for example, saturated calcium chloride solution and hydrochloric acid) and formaldehyde, the neutral hardened deamided material combines with no additional formaldehyde, whereas the untreated neutral hardened casein may increase its formaldehyde content by about 100 per cent.

Partial deamination is also possible without the removal of amide nitrogen. The partially deaminated product combines with a reduced quantity of formaldehyde under neutral conditions. In contrast to this, the same partially deaminated product combines with a normal quantity of additional formaldehyde when treated with formaldehyde, salt and acid.

Further confirmation of the conception of a reaction between formaldehyde and the amide groups of proteins is given by experiments with the protein zein. Only 0·4 per cent of formaldehyde combines with this protein when it is hardened in a neutral solution. In the presence of salt and acid, however, its combined formaldehyde increases to 4·1 per cent. These figures are in keeping with the low amino and high amide contents of zein.

It is concluded, therefore, that at or near the isoelectric point of the protein, formaldehyde combines with the amino groups mainly derived from lysine residues. Under more acid conditions it combines with the amide groups which are attached to residues of glutamic and related acids. A more detailed account of the investigation will appear elsewhere.

We thank the directors of Messrs. Courtaulds, Ltd. for permission to publish this communication.

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March 24.

Methionine in the Treatment of Liver Damage

RECENT investigations on protein metabolism and nutrition have increasingly emphasized the importance of individual amino-acid deficiencies in producing specific clinical states and pathological appearances[1]. It has been shown[2] that fatty livers can be produced in rats by dietary control. This latter work, and the findings of Miller and Whipple[3] that methionine could protect the liver against damage by chloroform, suggested to us that the present epidemic of infective hepatitis and the increased incidence of 'post-arsphenamine' jaundice might in some measure be conditioned by a sub-optimal protein intake leading to a latent methionine deficiency.

In 1942 we commenced a series of investigations along three main lines: (*a*) the prevention of liver damage during arsenical treatment for syphilis; (*b*) the treatment of established liver damage in cases of infective hepatitis and 'post-arsphenamine' jaundice; and (*c*) the treatment of patients gravely ill with liver dysfunction extending over a period of many weeks or months. Our observations in the prevention of liver damage during arsenical treatment, to be published in detail shortly, have made it abundantly clear that liver damage can either be prevented or minimized by the administration of methionine or by the use of casein digests rich in methionine which have had cystine added to them. The addition of cystine apparently was of value because of the methionine-sparing action of the cystine.

Owing to the extremely variable severity of infective hepatitis and of 'post-arsphenamine' jaundice, the value of any treatment or treatments can only be appraised statistically and after many hundreds of cases have passed through our wards. So far, pre-

liminary results based on a study of 450 cases, including controls, would appear to show that the clinical course of the above diseases is influenced beneficially, and the period in hospital significantly shortened, by treatment either with pure methionine in properly regulated dosage or by feeding patients with rapidly absorbable casein digests rich in methionine. In gravely ill patients, the results obtained by methionine treatment have been so striking as to leave no doubt as to the efficiency of the treatment, especially in those cases which have remained jaundiced for weeks or months and were in a state of *icterus gravis* when methionine treatment was initiated.

All our work has convinced us of the importance of an adequate protein intake, and more specifically of those proteins rich in methionine, in preventing and treating liver damage due to widely differing causes. We can therefore substantiate in large measure many of the suggestions put forward by Himsworth and Glynn[4] as a result of their experimental work on rats.

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Effect of Vitamin C on the Adrenaline Content of the Adrenal Glands of Guinea Pigs

I HAVE shown[1] that the insulin content of the pancreas is markedly diminished in scurvy. This may be due to a lowered vitality of all the tissues of the scorbutic animals or to the existence of a specific relation between vitamin C and the insulin content of the pancreas. As is known, the adrenal glands are concerned in carbohydrate metabolism. The adrenaline content of the adrenal glands was, therefore, studied in scorbutic and normal guinea pigs.

Guinea pigs on a scorbutic diet for 22–25 days, and guinea pigs fed with normal diet for 15 days, were starved overnight and the adrenal glands were removed next morning. The adrenal glands were extracted with trichloracetic acid for adrenaline and ascorbic acid according to the method of Rees[3]. This method was adopted as the value of adrenaline thus determined in adrenal gland extracts was found to correspond to that determined biologically. The results are summarized in Table 1 and the statistical analyses of the individual figures are given in Table 2.

The results show a highly significant increase in the adrenaline content of the adrenal glands in scurvy as opposed to the decrease in the insulin content of the pancreas[1]. The diminished insulin content of the pancreas of the scorbutic guinea pigs is, therefore, not merely due to the lowered vitality of the tissues of the animals. The action of vitamin C on the secretion of insulin appears to be specific in some degree, as the insulin content of the pancreas is not altered in vitamin B_1-deficiency[4], which also affects carbohydrate metabolism.

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TABLE 1.

	No. of animals	Average weight per animal	Weight of adrenal per 100 gm. body wt.	Ascorbic acid per gm. of adrenal	Adrenaline per gm. of adrenal	Adrenaline per pair of adrenals
Scorbutic guinea pigs ..	21	339 gm.	100·0 mgm.	0·035 mgm.	719·2 μgm.	223 μgm.
Normal guinea pigs ..	20	315	61·2	1·002	353·8	66

TABLE 2.

	Wt. of adrenal per 100 gm. of body wt.	Ascorbic acid per gm. of adrenal	Adrenaline per gm. of adrenal
Difference of the means	38·8 mgm.	0·967 mgm.	365·4 μgm.
Standard error of difference	6·187	0·13078	74·66
t	6·27	7·39	4·89
Remarks	Highly significant	Highly significant	Highly significant

White Plumage of Sea-Birds

IN a recent communication[1] on this subject, Craik makes some suggestions which we have attempted to examine further. A simple experiment in which conditions natural to fish were imitated was made on the flat roof of the Zoology Building here. The observer looked vertically upwards through a glass trough filled with water at a piece of opaque cardboard 3 in. × 5 in. in size held 6 ft. above his head. The agitation of the water by the wind made visibility of details very poor. With any overcast sky, when the observer was presented successively with a black and a white piece of cardboard, he was unable to tell which was which. But when the sun was shining on them, the white cardboard was at once distinguished from the black.

Now it can be calculated that when the sky is overcast the brightness of a horizontal white surface illuminated by the light reflected from the sea is of the order of only a tenth of the brightness of the sky (the reflexion factor of water is 0·02 for normal incidence). Its contrast against the sky will thus be about 0·9, as compared to 1·0 for a perfectly black object. At close range the horizontal parts of a white bird or aircraft must therefore be expected to appear (like the white cardboard) very dark against the sky. The difference of contrast just mentioned can, however, affect the critical range of visibility. The light scattered by the air-layer between the eye and an aeroplane will decrease the contrast between the latter and the sky. The intensity of scattered light needed to reduce the contrast from the value at close range to the smallest contrast perceptible by man (of the order of 0·01) is 0·89 for a white object and 0·99 for a black object. If the intensity of the scattered light is proportional to the distance, one would thus expect the range at which they became invisible to be about 10 per cent shorter for white than for black aircraft. We have assumed here that the critical factor affecting visibility is intensity discrimination, that is, the retinal image is large and the value of the differential threshold is not dependent on its size. But as the range

of vision of fish is believed to be small, their threshold of visibility will scarcely be affected by atmospheric scattering and cannot depend only upon intensity discrimination as such. However, as Dr. Craik pointed out in discussion, when atmospheric scattering is negligible, the range of visibility of a white object will still be smaller than that of a black one. An object will become invisible when it is so far away that its image on the retina reaches a certain minimum size for any given brightness. If the threshold of visibility is a function of the product area by contrast only, then since area decreases as the reciprocal of the square of the distance, the difference in range should now be about half as great as it was for intensity discrimination alone. But the contrast to be taken into consideration here is the average contrast (say 0·8) of the object, rather than the contrast of the darker parts. The difference between the critical ranges of visibility of black and white objects will thus be again of the order of 10 per cent. It may be pointed out, however, that a black bird 10 per cent smaller in linear dimensions than a white bird would become invisible at the same range as the latter.

When the sky is clear, the situation is different. If direct sunlight strikes the white plumage of a bird, the latter will acquire a brightness of the order of 25,000 candles/m.[2] (the sun giving an illumination of 100,000 lux)[2]. This brightness is much above that of blue sky, which is stated to be[3] 4,000 candles/m.[2]. This agrees with what we observed in our experiment. In sunshine, white birds may therefore be very conspicuous to fish, and if anything more so than black.

It is therefore not clear that white birds are on the whole less easily seen than others, and in this way stand at an advantage. A closer analysis of the problem from the fish's point of view shows how complex it really is. For example, as the surface of the sea is generally agitated, it is not certain what a marine fish does see of objects in the air. Ward's[4] observations suggest that they would see very little. There are at the edges of the 'window' in the area of total reflexion dark ripples which may well be confused with birds. This casts doubt upon the implicit assumption on which the above calculations are based, namely, that the fish take action as soon as the bird becomes visible. Definite information is needed about the actual stimuli which make fish dive.

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March 23.

[1] Craik, K. J. W., Nature, 153, 288 (1944).
[2] Fabry, Ch., "Les Principes de la Photométrie en Astronomie et en Physique", Mémorial des Sciences Physiques, Fasc. XXIV (Paris, 1934).
[3] Walsh, J. W. T., "Photometry" (London, 1926).
[4] Ward, F., "Animal Life Under Water" (Cassell, London, 1919).

As Pirenne and Crombie have pointed out above, scattered light can, in the long ranges at which aircraft are spotted, have an effect on contrast which is not present at short ranges, but calculations for short ranges show that one might expect a considerable difference in spotting range for black and white birds. A considerable part of the brightness of a roughly hemispherical object such as a bird, seen from below with overcast sky, is contributed by skylight and not by light reflected from the sea. Estimating the reflexion factor of the bird's plumage at 0·9, this would make the mean brightness of the underside about 0·15 of that of the cloud background. This should have a definite effect on maximum spotting range, for at the human threshold, in clear air, the visibility of an object of high contrast is determined mainly by the total reduction in incident light or 'subtractive energy', that is, the contrast multiplied by the angular area. Thus an object of half the background brightness will require to have about twice the area, or to be brought to about $1/\sqrt{2}$ of the distance, to be visible. The same is likely to apply to fish (though their absolute visual acuity is poorer); and for objects blurred, as Pirenne and Crombie point out the image of the bird will be, by surface ripples. On this basis, a contrast of 0·85 should produce a 7 per cent reduction in spotting range, which is of the same order as that to be expected with aircraft. Further, the conditions of cloudless blue sky, under which the bird will be brighter than the sky, are rather rare in temperate climates and there will be other conditions, such as sun shining through breaks in cloud, in which the brightness of the bird may exactly equal that of the background.

Rough experiments with paper disks on white backgrounds confirm this, particularly for peripheral vision, in which human acuity is poorer and perhaps approximates more closely to that of fish. To exaggerate the contrast very slightly, and thus obtain definite results with relatively few readings, punched paper disks of dead black and grey paper 5 mm. in diameter were mounted on white card, giving measured contrasts of virtually 1·0 and of 0·75. They were viewed at 15° from the visual axis, at the following distances. A blank card was sometimes presented, and the number of times when the observer failed to report the presence of a spot was recorded; he took about 5 sec. to judge.

	Grey spot	Black spot	No spot
Observer A			
Errors at 4·2 m.	17/20	1/20	0/20
Errors at 3·75 m. (— 10%) ..	11/20	0/20	0/20
Errors at 3·4 m. (— 20%) ..	1/20	—	0/20
Observer B			
Errors at 3·8 m.	15/20	2/20	2/20
Errors at 3·4 m. (— 10%) ..	5/20	—	0/20
Errors at 3·0 m. (— 20%) ..	1/20	—	0/20

Thus the errors at the longer distance are markedly greater with the grey than with the black spot, and when the distance is reduced the errors on the grey disk decrease, equalling at somewhere between 10 and 20 per cent shorter range those obtained with the black disk at full range. This is in good agreement with the above theory, on which the reduction for this contrast should be $1-\sqrt{0{\cdot}75}$ or 13 per cent. Thus there should be some advantage in white plumage if fish dive as soon as the bird reaches threshold visibility, but I agree that whether in fact they do so should, if possible, be directly investigated.

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Dr. K. J. W. Craik's suggestion[1] that the white coloration of sea-birds is adaptive in the sense of rendering them less conspicuous to their prospective victims cannot be considered convincing in view of the following difficulties.

A by no means negligible number of predomin-

antly white sea-birds, among them some albatrosses and shearwaters, do not feed mainly on living fish, but on organisms not endowed with sufficiently long sight for the coloration of the bird predator to be of importance. Some of these birds feed chiefly by night, when white coloration is not of any obvious advantage. Gulls are primarily scavengers.

It is difficult to believe that dark coloration would be a disadvantage to such a bird as a gannet plunging almost vertically at high speed on its prey. There is no evidence that gannets or boobies in immature brown plumage are thereby handicapped in catching fish. The same may be said of the dark-plumaged immature sooty terns.

Diving birds which hunt fish are not infrequently brilliantly coloured or dark—both those which dive from a perch or hovering position, such as kingfishers, or others, such as guillemots, mergansers and cormorants, which dive from the surface of the water.

The white coloration of some large birds, such as swans, appears to be related to their relative immunity from predators and not to feeding habits.

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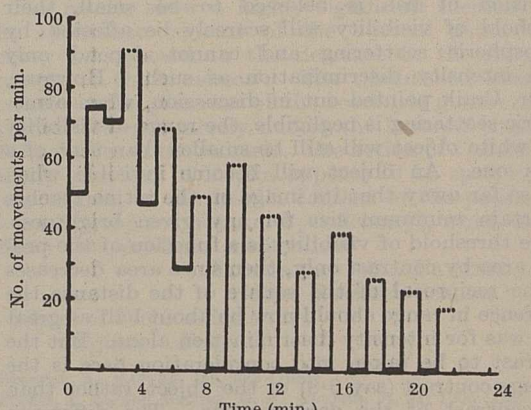
[1] NATURE, 153, 288 (1944).

Immediate Effect of X-Rays on the Movements of Larvæ and Pupæ of Mosquitoes

DURING X-ray experiments with larvæ and pupæ of mosquitoes (Culex), irradiated specimens were observed to accelerate their movements immediately after the onset of irradiation. When the irradiation is interrupted, they return at once to normal behaviour. Since we could find no description of the phenomenon, we attempted to study it in detail, as it appeared to constitute an immediate reaction to X-rays.

Larvæ and pupæ of the mosquito *Aedes ægypti* were used, because they were available in numbers, and their movements can be readily counted. The number of movements per minute was taken as a measure of activity. In order to determine the activity of the larvæ and pupæ under normal conditions, their movements were counted during three consecutive minutes before the beginning of irradiation. This number varies in different individuals from 30 to 80 per minute. The individuals were then subjected to successive irradiations of one minute, alternating with interruptions of the same duration. One larva or pupa at a time was exposed to irradiation in hollow slides filled with water, the diameter of the hollow being 9 mm. Throughout each experiment the specimen remained in position under the X-ray tube, the interruptions of the treatment being effected by closing the X-ray exit with a lead shutter.

A demountable tube was used as X-ray source. The anticathode consists of copper and the exit of the rays is closed by a thin aluminium sheet 30 μ in thickness. The tube was operated with a tension of about 35 kV. max. and a current of 10 m. amp., the intensity being 38,000 r./min., the irradiated specimen being 38 mm. from the anticathode. The characteristic course of the experiments is shown in the accompanying graph. The activity during irradiations and interruptions was determined as described above.



Activity of a pupa of *Aedes ægypti*

The difference in activity during irradiations and breaks is clearly seen. Activity is distinctly increased during irradiation by 20–60 movements per minute. As the experiment progresses the activity diminishes and finally ceases entirely during the breaks, whereas during the irradiation the specimen continues to move actively for a period of about half an hour and even more. Different individuals may react differently to the irradiation with regard to both rate of movement and time of cessation, but the general course of the experiment is uniform.

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Cultures of Excised Leguminous Roots

WITH the development by White, Robbins, Bonner and others of a technique permitting the culture of root systems from excised root tips, the possibility arose that the method might profitably be employed in studies of leguminous root nodules. Certainly if it proved possible to secure nodule formation on root cultures, then the investigation of some problems associated with the symbiosis between legume and nodule organism would be facilitated. So far as I am aware, there has been only one published record of an attempt to secure the nodulation of excised leguminous roots, namely, that of Lewis and McCoy[1]. Working with excised bean roots growing in agar, they observed the development of four nodules upon one root out of sixty that were cultured.

I have investigated the possibility of inducing the formation of nodules on excised roots of maple pea (Pisum). Excellent growth of roots of this species has been obtained in the medium formulated by Bonner[2], which includes inorganic nutrients, sucrose, vitamin B_1 and nicotinic acid. The procedure adopted is to germinate surface-sterilized and imbibed seeds of maple pea on agar plates until the radicles are 1–2 cm. long. Tips 0·5 cm. in length are then excised and transferred to flasks containing a shallow layer of the sterile nutrient solution. From such tips, roots 10–12 cm. long have developed within two weeks, while after longer periods roots up to 40 cm. in length have been obtained, well supplied with laterals, without any renewal of the medium. The roots bear short root-hairs, but as noted by Bonner[3], no secondary thickening has been observed.

The inoculation, with appropriate nodule bacteria, of excised pea roots growing in the above culture solution has not resulted in nodule formation. The organisms multiply in the medium, forming slimy strands adhering to the root surface, but the brief microscopic observations so far made reveal no curvature or primary infection of the root hairs. This last point obviously deserves much fuller investigation.

It seemed possible that the nitrate of the Bonner medium might be exerting an inhibiting effect, since it is well known that the presence of combined nitrogen tends to reduce the extent of nodulation of a leguminous plant. Initial reduction of the level of nitrate, however, markedly reduces the growth of the excised roots themselves. The method was therefore adopted of transferring well-grown roots into a medium with reduced nitrate and then inoculating. Control roots remained healthy and showed some growth, but no nodules developed in the inoculated cultures. It was also observed that good nodulation can be secured on 'whole plant' cultures of pea growing with their roots immersed in the Bonner medium with full nitrate (no sucrose).

Attention has also been given to the possible effect of the sucrose content (4 per cent) of the Bonner medium. Tests carried out under aseptic conditions with whole pea plants growing in nutrient agar or in sand watered with the nutrient solution suggest that this concentration of sugar interferes with nodule formation (see table).

Concentration of sucrose (per cent)	4	3	2	1	0·5	0·1
Average number nodules per plant	1·2	3·2	4·0	6·2	12·5	16·3

The excised roots, however, require the 4 per cent concentration for vigorous development, a reduction even to the 3 per cent level leading to lessened growth. Well-grown roots were transferred to solutions low in sucrose before inoculation, but although the bacteria survived and multiplied, no nodules were formed.

It is obviously a possibility that the Bonner medium, though providing all requisite factors for primary growth, is short of some accessory factor necessary for nodule formation. In the intact plant this factor may pass down from the stem and leaves[4], although it may be noted here that in pea the current incidence of light upon the shoot does not appear to be necessary for nodule formation, since I have observed as many as 26 nodules per plant on fully etiolated plants rooted in agar[4,5]. Experiments in which top extracts have been added to inoculated excised roots have not resulted in nodulation. The findings of Wipf and Cooper[6] may be of significance in these attempts to secure nodulation on excised roots, which were no more successful with excised roots growing in agar media.

The above investigations (now interrupted) followed some preliminary work by Miss Helen Fraser, and were carried out during the tenure of a Robert Donaldson Research Scholarship under the direction of Dr. G. Bond, who also gave assistance in the preparation of this preliminary account.

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Feb. 26.

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Absorption in the Atmosphere and Decay of Cosmic Rays

IN a former communication[1], an account was given of the hourly records of cosmic-ray intensity which are being made in London by registering threefold coincidences between three trays of Geiger-Müller counters without using any absorbing screen. The full description of the apparatus is given elsewhere, together with a complete account of the analysis of the data corresponding to the first few months of observation.

For the first part of this analysis, the hourly numbers of cosmic particles averaged in groups of 24 hours were correlated with the barograph readings at the station averaged over the same intervals. The correlation coefficient thus obtained has the high value — 0·87, and the barometric coefficient β represented by the slope of the corresponding regression line is $\beta = 3{\cdot}45$ per cent per cm. mercury, or $2{\cdot}53 \times 10^{-3}$ cm.^{2}/gm. This value of β is consistent with those formerly found by counter measurements, although greater in general than the value obtained with ionization chambers.

The principal object, however, of this provisional analysis of our data has been to separate the effects of absorption and decay which, on the hypothesis of the instability of the hard component, together determine the barometric coefficient. This separation has been made by establishing that the variation of the number N of cosmic particles at ground-level is a function first of the variation of the air mass (represented by the barograph reading B at the station) and secondly of the change in height $H - H_m$ of the pressure-level at which mesons are generated; this function is expressed by the equation

$$N - N_m = \mu(B - B_m) + \mu'(H - H_m),$$

where the subscript m refers to mean values. Clearly μ represents the true absorption coefficient in air, and μ' the mean rate of decay of mesons.

We do not know the pressure at which mesons are formed; but it is possible to ascertain what would be the most likely pressure between 760 mm. and 75 mm., the heights of which can be found from meteorological observations. This can be ascertained by comparing the *partial* correlations $R_{NH,B}$, that is, the correlations for B constant, between the mean daily number of cosmic rays at ground-level and the heights corresponding to different pressure-levels for the same days. The accompanying table gives the values of $R_{NH,B}$ for the pressure-levels which have been chosen. Only the mean daily numbers of cosmic rays corresponding to days for which the meteorological data from the ground up to 16 km. were complete (80 in all) have been used, so that the values of $R_{NH,B}$ should be entirely comparable.

Pressure level	$R_{NH,B}$
75 mm. (16·1 km.)	— 0·67
113 mm. (13·5 km.)	— 0·54
188 mm. (10·3 km.)	— 0·32
375 mm. (5·5 km.)	— 0·30

The gradual increase of $R_{NH,B}$ with height, as shown by the table, seems to indicate that the appropriate pressure-level to be used in the equation is 16 km. or higher. On the other hand, the great significance of the value — 0·67 for the corresponding correlation justifies the presence of the second term on the right-hand side of the equation, thus confirm-

ing the view that a part of the variation of the cosmic ray intensity at ground-level may be explained by spontaneous disintegration of mesons in the atmosphere.

The increase of the correlation with height does not imply, of course, that mesons are formed at the layer of 75 mm. pressure. They may be generated at higher layers, as suggested by the experiment of Schein, Jesse and Wollan[2]; but we can substitute for $H - H_m$ in the equation the fluctuations in height corresponding to 75 mm. pressure and thus obtain a first approximation to the regression coefficients. By so doing, and by applying the method of least squares, we obtain for the coefficient of true absorption:

$\mu = 2{\cdot}28$ per cent per cm. mercury, or $1{\cdot}68 \times 10^{-3}$ cm.^{2}/gm.

Ehmert[3] has measured the absorption curve in water and shown that the absorption coefficient down to a depth of 45 m. is given by the formula $\mu = 1{\cdot}56/h$, where h is the depth in gm./cm.^{2} On the other hand, from the theoretical results obtained by Rossi and Greisen[4] for the range of mesons in air, iron and lead, we have estimated that the ratio of the range in water to that in air would be about 0·9 for mesons of energy not greater than 10^9 eV. Assuming that Ehmert's formula is valid for air, and by applying the latter ratio to obtain the mass of water equivalent to the mass of air (thickness of the roof and counter-box included) above our apparatus, we obtain $\mu = 1{\cdot}65 \times 10^{-3}$ cm.^{2}/gm., which is nearly the same as that obtained from our observations.

For the second regression coefficient or mean rate of decay of the meson we obtain $\mu' = 0{\cdot}054$ per km., or $0{\cdot}94 \times 10^{-3}$ cm.^{2}/gm.

Kolhörster and Matthes[5], by registering double coincidences while compensating for the variation of atmospheric pressure with a variable wood screen, have found for μ' the value $1{\cdot}15 \times 10^{-3}$ cm.^{2}/gm., which is of the same order. Taking into account, however, that no absorbers are used in our arrangement, allowance should be made for the amount of soft component which is recorded by the apparatus, and therefore the actual value of μ' should be greater.

For the mean range of the meson before disintegration, we have

$$L = \frac{1}{\mu'} = 18{\cdot}6 \text{ km.}$$

The mean life when at rest of a meson of 3×10^9 eV. energy would be $\tau_0 = 1{\cdot}6 \times 10^{-6}$ sec.

As to the temperature effect α, its value can also be obtained immediately by making use of Blackett's expression[6] $\alpha = -\delta z/L\delta\theta$. From meteorological data, $\delta z/\delta\theta = 0{\cdot}065$ km., for $z = 16$ km.; hence

$\alpha = -0{\cdot}35$ per cent per °C.

This value is greater than that generally found, but this was to be expected since α has been usually referred to the temperature near the ground.

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Roozeboom's Type II of Solid Solution

ON p. 20 of Jänecke's "Kurzgefasstes Handbuch aller Legierungen" (Leipzig: Spamer, 1937), there is the following statement: "Es wurde früher vielfach noch ein Typus vollständiger Isomorphie angenommen, bei dem Schmelzpunkt-maximum auftreten sollte, obwohl hierfür niemals ein Beispiel gefunden war und auch schon von langen Jahren van Laar durch thermodynamische Betrachtungen nachgewiesen hatte, dass ein solcher Typus nicht auftreten könnte. Er wurde aber noch von Roozeboom angenommen, wodurch sich diese Auffassung noch in verschiedenen Lehrbüchern erhalten hat".

Early in 1939, I wrote to Prof. Jänecke (to whom I am personally unknown), asking him how he accounted for the existence of an apparent confirmation of this type in the well-known system *d*- and *l*-carvoxime (Adriani, *Z. physikal. Chem.*, **33**, 469; 1900). The following is Prof. Jänecke's reply, dated April 24, 1939. "Das bekannte System: *d*- und *l*-Carvoxim und das neue: Malonsäure (—) monobornylester und M(+) ester ist kein Widerspruch mit dem von mir auf S.20 meines Buches gemachten Behauptungen. Es handelt sich in diesen Fällen ausgesprochenerweise um eine Verbindung, die beiderseits Mischkrystalle bildet. Es bilden sich entweder Mischkrystalle von (*d* — *l*) mit *d* oder mit *l*. Die Darstellung zerlegt sich in zwei Teile. Vermutlich wurden sich bei organischen optisch aktiven Stoffen noch mehr Beispiele finden. Anderseits wird sich der Fall auf diese [word undecipherable] Verbindungen beschränken. In dem Nachtrag zu meinem Buche der Ende dieses Jahres erscheinen soll, werde ich hierauf noch kurz eingehen".

The reference to van Laar appears to be *Z. physikal. Chem.*, **63**, 216–253 (1908), the crux of the matter occurring on pp. 235–236. Van Laar deduces the inequality:

$$(\alpha_2 - \alpha_2') < q_2 \cdot \frac{T_1 - T_2}{T_2}$$

as the determining condition for a falling equilibrium temperature. T_1 and T_2 are the absolute melting points of the pure components, T_1 being the higher: q_2 is the heat of fusion of the lower melting component: α_2 and α_2' are constants determining the differential heats of mixing of the low melting component in the liquid and solid phases respectively. From here on I use van Laar's own words: "Ist nun $T_1 > T_2$ so ist das zweite Glied dieser Ungleichung immer positiv. Das erste Glied wird jedoch stets negativ sein, da die Grösse α_2' (welche die Mischungswärme in der festen Phase bedingt) in allen normalen Fällen $> \alpha_2$ in der flüssigen Phase ist. Die obige Ungleichung wird somit sicherlich stets erfüllt sein, so dass die Schmelzcurve wohl niemals bei der höchsten Schmelztemperatur zu steigen anfängt, und ein Maximum folglich so gut wie ausgeschlossen ist." I add that van Laar's demonstration is not, like many of the demonstrations of the Dutch school, dependent on van der Waals' theories of state.

The matter is of some importance, since many text-books of physical chemistry, including one with which I am myself associated, includes the erroneous diagram.

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RESEARCH ITEMS

Antibiotics from *Aspergillus fumigatus*: Identity of Helvolic Acid and Fumigacin

The mould *Aspergillus fumigatus* gives rise to no fewer than four crystalline metabolic products possessing antibacterial activity. Of these, two compounds, fumigatin and spinulosin, have been definitely characterized and identified (Anslow and Raistrick, *Biochem. J.*, **32**, 687 and 2288; 1938; Oxford and Raistrick, *Chem. and Ind.*, **61**, 128; 1942). They are, in fact, closely related and have the constitutions 3-hydroxy-4-methoxy-2 : 5-toluquinone and 3 : 6-dihydroxy-4-methoxy-2 : 5-toluquinone, respectively. A third product, helvolic acid, m.p. 204·5–212°, was isolated from *A. fumigatus* mut. *helvola* and described by Chain, Florey, Jennings and Williams (*Brit. J. Exp. Path.*, **24**, 108; 1943). It is nitrogen free and has the empirical formula $C_{32}H_{44}O_8$ (deduced from ultimate analysis and X-ray mol. wt. data) and forms a monomethyl ester. Nothing further is known as to its constitution, but the substance is stated to be relatively non-toxic to animals, although active against Gram-positive organisms, for example, *Staphylococcus aureus* at 1 : 80,000, complete inhibition. Prior to this discovery another antibiotic from *A. fumigatus* was described by Waksman, Horning and Spencer (*Science*, **96**, 202; 1942; *J. Bact.*, **45**, 233; 1943) and was given the name fumigacin. It was stated to have a melting point of 185–187°, to contain 3·7 per cent of nitrogen and to be active against Gram-positive bacteria. In a forthcoming issue of *Science*, Waksman states that Menzel, Wintersteiner and Hoogerheide have demonstrated that fumigacin as prepared by Waksman contains some 20 per cent of gliotoxin, $C_{13}H_{14}N_2O_4S_2$, an antibiotic from *Gliocladium fimbriatum* and toxic to animals (Johnson, Bruce and Dutcher, *J. Amer. Chem. Soc.*, **65**, 2005; 1943). On removal of the gliotoxin fraction, the purified fumigacin was found to be identical with helvolic acid in chemical composition, antibacterial activity and *in vivo* activity. The antibacterial metabolic products of *A. fumigatus* so far identified are therefore fumigatin, spinulosin, helvolic acid (or purified fumigacin) and gliotoxin.

Termites and Soil Fertility

A. M. Adamson, of the Imperial College of Tropical Agriculture, Trinidad, has discussed the relation of termites to soil fertility (*Trop. Agric.*, **20**, 107; 1943). The most important of the activities of termites, in so far as they bear upon soil fertility, are probably: (1) consumption of dead wood and other plant remains, thereby accelerating the formation of humus; (2) movement of soil above the surface, for building nests and covered passages, thereby exposing the soil to weathering and promoting its admixture with humus; (3) making subterranean tunnels, which are exceedingly abundant and promote aeration, drainage and root penetration. In dry areas of sparse vegetation, the amount of organic matter in the soil may be seriously reduced if too many termites are present, but it is a subject which does not seem to have been investigated. Harvester termites attacking grasses denude parts of the velds of Africa, causing erosion. Much research, however, is necessary to elucidate the relations between soil fertility and the incidence of termites. Much work is also required on the composition of the materials forming the termitaria or habitations of these insects, and on their feeding habits in relation to organic matter in the soil. It is noteworthy that as regards their mode of life the termites fall into two natural groups. First, those of the family Kalotermitidæ, which live almost exclusively within dead wood. Their only activities affecting soil fertility are the consumption and disintegration of such material. The second group comprises the remaining families of the termites. Their members spend almost all their lives in intimate contact with the soil, and all of them apparently influence it in one way or another.

Laboratory Strains

R. Lamy (*Proc. Roy. Soc. Edin.*, **62**, 9; 1943) has discovered an interesting divergence in the genotypes of different strains of *Drosophila pseudo-obscura*. This sheds some light on the validity of laboratory experiments for the solution of problems in the wild. She shows that backcrosses between Race *A* with marked *X*-chromosomes, and Race *B* of this species, sometimes exhibit non-viability of one or both sexes. Different strains differ in this reaction with a wild strain. The non-viability is greatly influenced by other genes on the autosomes. This divergence appears to be correlated with the length of time the strains have remained in isolation. The author suggests that the presence of a major gene in a strain may alter the selective value of many subsidiary genes, and this in turn would lead to a directional drift of the genotype as a whole. As a consequence, different strains containing one or more primary gene differences from another would be expected to diverge more and more from the original type.

Genetics of *Papaver alpinum*

A valuable analysis of the taxonomy, genetics and distribution of the group *Papaver alpinum* has been made by A. C. Fabergé (*J. Genetics*, **45**, 139; 1943). This aggregate species has a more restricted range than *P. nudicale* but exhibits a considerable number of variants in the wild. These correspond to characters which are unifactorial in inheritance in cultivated *P. alpinum*. A diagnostic key and a distribution map are given by the author, who discusses the possible evolution of the group. The Sewell-Wright effect of random genefixation would appear to play a large part in the creation of a population uniform for apparently non-selectable characters. These populations may be relics. Eleven genes are identified. One locus has three allelomorphs. Linkage tests show the existence of two linkage groups, of which one has five loci and the other three loci. In the first group, covering seventy units, there is little interference, which is similar to the reported data in *Primula sinensis* and Zea and rather different from Drosophila.

Mosaic Disease and Fruiting of the Tomato

Reduction in the yield of tomato plants infected with mosaic virus has been described by several authors. A more detailed investigation has recently been made by Ireson W. Selman (*J. Pomol. and Hort. Sci.*, **20**, Nos. 3 and 4, Oct. 1943). Mosaic-infected and healthy plants were studied at two levels of liming and three levels of potash manuring. The total number of flower buds per plant was not affected by mosaic infection, but was reduced by liming and the addition of potash. Total numbers of fruits were,

however, reduced by mosaic infection and by liming, but were unaffected by the level of potash. An interesting fact is that liming, potash manuring and mosaic infection all depressed the yield of fruit, suggesting that the tomato crop is not benefited by excessive manuring. This conclusion has recently been reinforced from other directions. Mosaic infection reduced the yield of fruit at all levels of lime and potash, and also increased the severity of severe blotchy ripening. This indicates a possible connexion between the virus and potash metabolism within the host plant. It focuses attention upon the need for careful control of potash manuring, particularly with the variety 'Potentate', on which the experiments were performed.

Mineral Resources of Eire

EMERGENCY PERIOD PAMPHLET No. 1 of the Geological Survey of Ireland (Stationery Office, Dublin) is a short review by D. W. Bishopp of Irish mineral resources and the possibilities of developing them. It is suggested that a limited quantity of coal will be obtainable for some time to come, though only with difficulty and expense, and that any rapid expansion of output to compensate for more than a fraction of the normal imports (now cut off) would be impracticable. In the case of metalliferous minerals, the mineral belt of Avoca still holds out some hope of further profitable exploitation. On the whole, however, the prospects of reviving an industry in copper are unfavourable, and the lead-zinc-silver deposits are also far from encouraging, though it is not overlooked that entirely new deposits or extensions of known ones may exist beneath the blankets of bog and glacial drift which hide vast areas of the underlying bedrocks. Of the non-metallic minerals which are at present being worked (structural materials; rock phosphate in the Carboniferous beds of West Clare; gypsum in the Trias of Carrickmacross and Kingscourt; barytes in Co. Sligo; pyrites, for sulphur, in Avoca; and quartz from Muckish) there is no likelihood of a shortage in the near future.

Potassium *para*-Phenolsulphonate as a Buffer

THE *p*H range of 8·6–9·0, between those for borates and secondary phosphates, is usefully filled by potassium *para*-phenolsulphonate. The purified product is not commercially available, but E. E. Sager, M. R. Schooley and S. F. Acree (*J. Res. U.S. Nat. Bureau of Stand.*, **31**, 197; 1943) find that the manufactured material may be decolorized by treating a hot solution with activated carbon and recrystallizing three times. A quantitative method of analysis by bromine titration is described. Ultraviolet absorption spectra showed differences between the primary and secondary salt, and indicated that the sulphonate group is almost completely ionized in dilute solution. Now that detailed information is available, it seems likely that potassium *para*-phenolsulphonate should find useful application as a buffer substance. In the same journal (**31**, 205; 1943), R. G. Bates, G. L. Siegel and S. F. Acree describe measurements of the thermodynamic second dissociation constant K_2 of *para*-phenol sulphonic acid by means of electromotive forces of hydrogen–silver chloride cells without liquid junction, using buffer mixtures of the potassium salt, sodium hydroxide and sodium chloride. The results between 0° and 60° C. are given by $pK_2 = 1961{\cdot}2/T - 1{\cdot}1436 + 0{\cdot}012139T$ (T = abs. temp.). The pH values of buffers having the molal ratios m_1/m_2 of phenolsulphonate and bivalent phenolate sulphonate ion between 2/3 and 1 are given by $p\text{H} = pK_2 - \log(m_1/m_2) - 3A\sqrt{\mu}/(1 + 8B\sqrt{\mu})$, where μ is the ionic strength and A and B are constants.

Non-linear Optics and Electrodynamics

FOR the past two years the Dublin Institute for Advanced Studies has been engaged on a series of investigations of the consequences of replacing Maxwell's electromagnetic equations by those of Born and Infeld, which are non-linear. The first paper, entitled "Non-linear Optics", by Prof. E. Schrödinger (*Proc. Roy. Irish Acad.*, **47**, 77; 1942), dealt, among other matters, with the mutual influence of light waves. It showed that light is refracted by light, and that two light rays experience mutual scattering. Further developments were given in later papers (*ibid.*, **48A**, 91; 1942; and **49A**, 4; 1943). The extension to non-linear quantum electrodynamics was undertaken by J. McConnell (*ibid.*, **49A**, 149; 1943), and showed the great complexity of the problem. The results agree closely with those already obtained in Schrödinger's papers, but there are grave difficulties to overcome, which, it is suggested, may be resolved by using the theory of radiation damping due to W. Heitler and H. W. Peng (*Proc. Camb. Phil. Soc.*, **37**, 291; 1941; and **38**, 296; 1942). The final conclusion is that we arrive at a reasonable theoretical picture of a process, which has never actually been observed, but is certainly small enough not to be in contradiction with the present negative experimental evidence.

Solar Flares and Magnetic Storms

H. W. NEWTON, in a paper with this title (*Mon. Not. Roy. Astro. Soc.*, **103**, 5; 1943), deals chiefly with magnetic storms that follow intense flares after several hours. A large amount of observational data has been collected between 1859 and 1942, and details of the time, duration and position on the disk of thirty-seven intense flares are listed. In twenty-seven cases magnetic storms began within two days of the flares, and the percentage association is higher for the central zone of the disk (0°–45°). The occurrence of the smaller storms, which show a recurrence tendency, is explicable on the theory of a corpuscular stream emitted more or less continuously for weeks, partaking of the sun's rotation, and overtaking the earth in its orbit at intervals of 27 days. This view cannot be reconciled with the occurrence of the great magnetic storms, which show no pronounced tendency to recur at intervals of 27 days, and the following features are suggested as operating in the latter case. A newly formed corpuscular stream is ejected at the time and place of the great flare, and when this stream reaches the earth's orbit in a period of about 20–26 hours, the five greatest storms giving the former period, the earth itself is included in a 'head-on' encounter. The stream of corpuscles has a wide front, the semi-angle of the equivalent cone being often as large as 40°, and sometimes greater. Although it is concluded that for every *great* magnetic storm there is a high probability that it has been preceded about twenty-four hours earlier by an intense solar flare, the smaller storms still present a problem. They continue throughout solar minimum, when great sunspots, flares and great magnetic storms have temporarily ceased (see also NATURE, April 15, p. 452).

X-RAY ANALYSIS IN INDUSTRY

CONFERENCE OF THE X-RAY ANALYSIS GROUP OF THE INSTITUTE OF PHYSICS

THE third Institute of Physics Conference on X-ray analysis in industry was held in Oxford on March 31 and April 1. This year it was organized by the newly formed X-ray Analysis Group of the Institute and followed the first annual general meeting. Attendance was not, however, confined to members of the Group; indeed, non-members were in the majority among the two hundred present.

The chairman of the Group, Sir Lawrence Bragg, presided. In opening the conference he pointed out that the title "X-Rays in Industry" does not mean that academic work is excluded; one of the main objects of the Group is to link more closely the work of the universities and of industry. This point was well illustrated by the papers read at the first session. The subject—the analysis of complex organic compounds—may have appeared highly academic, yet in the discussion it was obvious that it is of great interest to, for example, the rubber and plastics industries.

Complex Organic Compounds

In the first paper, Dr. E. G. Cox pointed out that there is no royal road to success in solving crystal structures; there is still a great deal of trial and error work, and the computations involved may be quite extensive. He emphasized that, for a complicated structure, a large number of approximate intensities is better than a few accurate ones. Moreover, it is almost a necessity to use three-dimensional methods except when a flat molecule is being studied. This is due to the low resolving power, which is only about 0·5 A.; the projections of atoms on a plane often fall closer than this, but in three dimensions they cannot be closer than 1A. Accuracy should not be sought for its own sake, but where accuracy is required, crystallographers should state precisely what they have achieved. It is necessary, above all, that their results should be dependable.

Dr. Dorothy Crowfoot gave an account of the work upon which she had been engaged with Dr. C. H. Carlisle, on the structure of cholesteryl iodide. She led up to this by a brief summary of the work of Bernal on the sterols, and pointed out the difficulties that often attend the investigation of such crystal structures. These difficulties can sometimes be overcome if the structure contains a heavy atom, since this will largely determine the relative phases of the structure amplitudes. Cholesteryl iodide gave an opportunity of trying out these ideas in the general case, for it has no centre of symmetry. In spite of this, it was found possible to derive the complete structure of one of the forms.

Two-dimensional Fourier synthesis was used and was supplemented by the information given by line synthesis through the peaks in the projection. There was, however, an inherent difficulty in that the method gave the correct structure overlaid with its mirror-image, and in order to sort out the true structure, knowledge of interatomic distances had to be used. Apart from the operation of finding which peaks represented related atoms, the determination of the structure was entirely direct.

Mr. H. M. Powell described some recent work he had done in collaboration with Dr. Huse and Mr. Cooke. This had as its aim the discovery of the nature of the intermolecular forces in aromatic compounds. A large range of compounds was first reviewed to see which were likely to be solvable. In agreement with Dr. Crowfoot, he stressed the value of a heavy atom in the structure; but he showed that this can have its limitations also. For a molecule containing three iodine atoms the detail of the carbon atoms was completely 'swamped'; with only one iodine atom, however (*para*-iodoaniline-*sym*-trinitrobenzene), it had been found possible to work out the complete structure by successive refinement of two-dimensional Fourier synthesis. The result arrived at was that the forces binding the molecules are certainly not covalent, but are probably of the van der Waals type, although some of the interatomic distances are rather short. Mr. Powell concluded by showing X-ray photographs containing 'smear' lines, and gave a possible explanation based on 'mistakes' in the packing of the molecules.

In the discussion, Dr. C. A. Beevers expressed the opinion that three-dimensional Patterson synthesis should be applied to structures that will not succumb to the methods so far described. The method is to calculate sections at special values of the parameters. Dr. Smare agreed with the possibilities envisaged, but said that in carotene, $C_{40}H_{56}$, it is surprising how many chance peaks occur in such planes. Dr. Cox explained this by the lack of resolution.

Dr. K. Lonsdale pointed out the need for correcting for extinction before improving methods of measurement of intensities. She showed some 'divergent-beam' photographs of certain organic crystals. These were very poor, but after the crystals had been dipped in liquid air, greatly improved photographs were obtained. The poor quality of the original photographs was due to the presence of extinction; dipping into liquid air decreased the perfection of the crystals and so decreased the extinction. Dr. H. Lipson also questioned the accuracy claimed by some workers; he gave theoretical reasons for thinking that an accuracy of 0·02 A. could not be reached with Fourier synthesis. Dr. G. A. Jeffrey, on the other hand, instanced the remarkable consistency of bond-lengths derived from different crystals.

Mr. C. W. Bunn thought that trial and error methods still have a place in the determination of structures, and that they have been given a new lease of life by the optical method devised by Sir Lawrence Bragg. Essentially this method reproduces with ordinary light the diffraction of X-rays by a crystal, and a complete zone of intensities can be determined in about an hour even for a complicated structure.

Dr. I. MacArthur urged the use of the variation of physical conditions, particularly temperature. He showed a set of X-ray photographs that have in this way produced valuable evidence of the structure of the ketones.

Finally, Prof. N. V. Sidgwick questioned the generality of Mr. Powell's conclusion that the forces between aromatic molecules are of the van der Waals type; it might be true for one compound, but not for others.

Fibres

The first session on the second day was devoted to fibres and other types of imperfect structure. Dr. W. T. Astbury showed diffraction photographs of a number of fibres, including 'powder-like' fibres

giving very diffuse rings, stretched poly-*iso*butylene, which gives sharp spots, and keratin fibres which give intermolecular patterns. He also showed photographs of such protein fibres as porcupine quill, which give many orders of diffraction, showing evidence of a spacing of more than 600 A. in the structure. The former fibres give much sharper photographs when stretched, while the latter do not.

The physical properties of a fibre are changed considerably when the fibre is wetted, but its diffraction spectra remain the same. Different fibres with very different strengths can give photographs indistinguishable from each other. Thus X-rays do not yet give complete information about the technical properties of fibres, since the X-ray spectra are due to the crystallinity of the fibre, while the mechanical properties depend mainly on the less organized (amorphous) parts, which only affect the background of the photograph.

Dr. E. Aruja described some work on the structure of chrysotile, one of the asbestos minerals. He showed an X-ray photograph in which some of the spots are drawn out into streaks along the layer lines, owing to imperfection in the structure. Chrysotile is formed of hexagonal sheets of SiO_4 units alternating with brucite layers, and since these layers have slightly different cell dimensions the sheets may be expected to be curved. This accounts both for 'mistakes' in the structure and for the fibrousness of chrysotile. The photometer curves of the streaks have been correlated with Warren's calculations on the intensity of diffraction from imperfect layer structures. Antigorite, a substance having the same chemical composition as chrysotile, differs in having a lamellar structure.

Mr. C. W. Bunn spoke on the structure of high polymers. Although one cannot obtain single crystals of these, they can be partially oriented by stretching or rolling, and the amount of X-ray evidence available is generally adequate for structure determination. There is generally 5–10 per cent of disordered material in polymer specimens. The usual methods of structure determination are employed, except that little use can be made of Fourier methods. The intensities calculated from trial structures based on stereochemical knowledge are compared with observed intensities, the values of which can be estimated visually with sufficient accuracy. For this purpose all available spectra must be employed. When the most probable structure has been found, there may still be some disagreement between calculated and observed intensities; this may often be attributed to anisotropic thermal vibrations, rotation of chains about their axis, and the distortion of electron clouds in $=CH_2$ groups. This last effect has been observed in polyethylene, and confirmed by evidence from 'thermal' spots.

Prof. H. L. Riley gave a summary of the theory of the formation of coals, and described work done with the object of elucidating coal structure. Chars produced at various temperatures from a number of organic compounds show a remarkable constancy of particle thickness of about 10 A., as indicated by the breadth of the 0002 reflexion. This is not so with coals, which give particle sizes varying with the charring temperature, the variation being of a different form for different coals. Part of this variation may be attributed to the packing of flat units under the influence of thermal agitation, but this packing would appear to reach a limit at 550° C. For the cause of subsequent changes we must look to the effect of heat on other components of coal. It is therefore interesting to observe that particle sizes of dibenzanthrone chars show much the same variation with charring temperature as those of coking coals.

In the discussion which followed, Dr. D. P. Riley spoke of the study by X-rays of 'amorphous' materials like carbon black, and said that diffraction photographs show three parts, interatomic, intermolecular and interparticle, the last-named occurring at the lowest scattering angles, and giving useful information about the particle sizes. Dr. G. Coumoulos described some plastics which always appear 'amorphous', in spite of stretching, owing to the presence of long side-chains in their structures. Dr. A. R. Stokes suggested that information about the form of 'mistakes' in a structure can be gained by using the fact that the only fuzzy reflexions are those for which the structure amplitude is changed by the mistake; the other reflexions are sharp.

Preferred Orientation in Wires and Sheets

The subject discussed in the final session was preferred orientation in wires and sheets. Dr. W. H. Taylor opened with a short account of the stereographic projection, which forms the basis of the pole-figure method of representing preferred orientation. He pointed out that, while the projection of a single crystal represents many planes, the pole figure of a polycrystalline material represents only one set; thus a series of pole-figures will in general be required for the same specimen.

Preferred orientation sets in after a material has been broken up into a mosaic structure by cold-work, that is, after the point at which fracture would have taken place in a straight tensile test. The mechanism of re-orientation involves both slip and twinning; but the latter has, as yet, received much less attention than the former.

Dr. Taylor then described some work on magnesium sheet containing 2 per cent of manganese. Transmission X-ray photographs were first taken; but the disadvantage was that only the average orientation over the whole thickness was studied. A better method was to take surface reflexion photographs and to examine the orientation at different levels by successive etchings of the surface. It was found that the basal plane (0002) of the hexagonal structure was brought approximately into the plane of the sheet. Below the surface a double orientation sets in, the basal plane tending to set at $\pm 15°$ to the plane of the sheet along the rolling direction. A complete description of the orientation is still lacking.

Mr. H. P. Rooksby described some results of the examination of tungsten and molybdenum wires and sheets. The drawn wire shows a texture characteristic of the body-centred cubic metals, [110]* tending to lie along the wire axis; this orientation is more closely approached the greater the reduction in diameter. Etching away the surface shows that the orientation becomes more nearly complete in the centre.

The rolling process restricts the orientation still further, since there is a tendency both for (100) to become parallel to the surface of the sheet, and for [110] to become parallel to the rolling direction. X-ray photographs show, however, that there is a

* Indices enclosed in round brackets represent planes; those enclosed in square brackets represent zone axes or directions in the crystal.

considerable deviation about the rolling direction. Successive rolling in two perpendicular directions reduces this deviation so much that the resulting sheet has almost the properties of a single crystal; in particular, it has a pronounced cleavage at 45° to the rolling directions, and this is very objectionable in practice. For this reason the successive rollings at right angles must be replaced by a uni-directional rolling.

Dr. J. T. Randall dealt with orientation properties of sheet steel for electrical machinery and transformers. Up to 4½ per cent of silicon is added to the iron from which these sheets are made in order to reduce the oxygen content and to increase the resistivity. The impurities left, however, still have a great influence on the magnetic and orientation properties of the material, which differ greatly from those of pure iron. The crystals in hot-rolled silicon-iron sheet are oriented with [110] parallel to the direction of rolling and (100) in the plane of the sheet, whereas cold-rolled (Goss) sheet has [100] and (110) in these orientations. The Goss sheet is therefore preferable for transformers, since [100] is the direction of easy magnetization and should therefore lie in the direction of the flux.

Dr. Randall emphasized the danger of introducing cold-work into the specimen; for most methods of X-ray examination it is usual to cut small pieces from the sheet, and the proportion of cold-worked to undeformed material is high. This difficulty cannot be overcome by etching, which itself may have some preferential effect. Methods which do not have these defects are the study of etch pits and the torque magnetometer.

In the discussion, Mr. G. C. Richer suggested that there may be disordered regions between the magnetic domains in transformer sheet; these cannot easily be detected by X-ray methods but they may influence the magnetic properties.

Dr. T. Ll. Richards underlined the necessity for using the stereographic projection, and described how he has studied the orientation of chromium plating.

Dr. W. F. Berg showed slides of some back-reflexion Laue spots from transformer sheet, and suggested that the fine structure they possess might give some information about slip planes in the crystals.

Mr. E. E. Spillett emphasized the importance of preferred orientation in aluminium. Nevertheless, there are still some problems left unsolved; for example, there does not appear to be any simple correlation between the hardness and the degree of preferred orientation in an annealed sample which was examined by X-rays. The orientation in aluminium tube is dependent on whether a reduction of diameter or of wall thickness predominates. In the former case, [111] is parallel to the tube axis as in drawn wire, and in the latter [112] is parallel to the axis as in rolled sheet.

Dr. A. Hargreaves described a moving film method of recording glancing-angle reflexions for a rotating sheet specimen; in this way the information necessary to draw almost a complete pole-figure for one set of planes can be obtained from one photograph, and Dr. Hargreaves has used it to show the double orientation in magnesium sheet.

In the evening of the first day of the conference, Dr. P. P. Ewald gave an entertaining account of the international development of crystallography. Being in the subject at its beginning, he was able to give personal recollections of most of the great men of the subject. He described the various meetings which have been held since the War of 1914–18 to discuss rational organization, and showed the undoubted influence that these meetings have had. He then discussed the progress of the subject in terms of the titles of books published, and concluded by a well-thought-out plan for the future.

REFORM OF SCHOOL MATHEMATICAL SYLLABUSES

A GENERAL meeting of the Mathematical Association, the first to be held since the outbreak of the War, took place at King's College, London, on April 12 and 13. The meeting attracted a large number of members; the president, Mr. W. C. Fletcher, took the chair during the first part of the meeting and Prof. E. H. Neville deputized for him later.

The afternoon session on April 12 was devoted to a discussion on possible changes in the mathematical syllabus for the various School Certificate examinations. The discussion was opened by Mr. C. T. Daltry, who outlined some preliminary work done by the Association in 1938 and went on to consider the alternative geometry syllabus recently introduced by the Cambridge Local Examinations Syndicate. The principal points in this syllabus are: (*a*) a reduction in the number of theorems to be proved; (*b*) a more definite fusing of geometry and trigonometry; (*c*) the introduction of more practical material from map reading, plan- and elevation-drawing, etc. Mr. Daltry advocated a similar type of reform in regard to algebra, where the reduction of formal manipulative work would leave time for more progress in graphs and functionality, and the possible introduction of the easiest parts of the calculus (as an optional subject). He further recommended the general adoption of the 'mixed-subject' type of examination paper, each paper to be divided into an easy section where accuracy might be the principal requisite, followed by a section in which a choice of questions should be given.

Dr. F. C. Powell gave an account of the circumstances leading to the introduction of the Cambridge alternative syllabus. After contrasting the mathematical and physical approaches to any subject, he stated that in this syllabus a physical approach to the teaching of geometry is contemplated. This has led to the retention of only those parts of geometry which are useful in developing applications and have a definite practical value, and to the rejection of parts of the work which, though interesting in themselves, have no bearing on such development. It is too early, he said, to make an exact assessment of the degree of popularity which the new syllabus will achieve, but the response so far has made it clear that teachers are very ready to welcome such changes.

An interesting discussion followed, in the course of which general agreement was expressed in regard to most of the points raised, though doubt was expressed by some members as to the advisability of introducing calculus at too early a stage.

At the conclusion of the discussion, four resolutions were proposed by Mr. G. L. Parsons. The first two of these, which were passed unanimously, were as follows:

(i) "This meeting of the Mathematical Association is in favour of a general revision of the syllabus in Mathematics demanded of candidates for the School Certificate examination."

(ii) "This meeting is in favour of a reduction in the number of theorems of which candidates are expected to produce a formal proof and approves of the general principle that the work in Geometry and Trigonometry should be more closely co-ordinated. A more extensive use of three-dimensional ideas and a more practical approach are also desirable."

The third resolution, which found only a few dissentients, was as follows: "This meeting considers that a reduction should be made in the amount of formal Algebra demanded and that the time thus saved should be given to the study of graphs and functionality."

A last resolution, passed by a substantial majority, read: "This meeting would approve the introduction of elementary Calculus, treated principally from a graphical angle, as an *optional* element in Elementary Mathematics papers".

The remainder of the proceedings on the first day were devoted to papers by Mr. W. W. Sawyer on "The Theory of Functions" and Prof. L. M. Milne-Thomson on "Harmonic Analysis".

The meeting re-opened on Thursday with a demonstration by Mr. C. W. Hansel of the use of an apparatus consisting of a large mirror mounted at 45° to the horizontal in the teaching of mathematics. This apparatus allows a class to get a clear view of diagrams and other objects placed in a horizontal plane. A paper on "Infinite Series for Fifth Formers", given by Mr. N. M. Gibbins, concluded the morning session.

The main discussion in the afternoon dealt with a new Higher Certificate mathematical syllabus, drawn up by the Science Masters Association assisted by a number of members of the Mathematical Association. The discussion was opened by Mr. E. H. Lockwood, who gave an account of the events which led to these proposals. He outlined the various levels aimed at in the syllabus, and explained how this syllabus could, by a certain amount of adjustment, be made to fit in with the syllabus required by potential mathematical scholars. In the minimum syllabus, which was planned for a five-term course, emphasis has been placed on calculus and the function idea at the expense of geometry; and elementary rotational dynamics at the expense of more elaborate statics. In the advanced section of the syllabus, the same ideas have been followed out, for example, by the preference of differential equations, determinants, vectors and complex numbers to the usual work on the geometry of conics.

Mr. A. E. E. Mackenzie continued the discussion on behalf of the Science Masters Association, giving some account of the general background and of parallel activities which are being pursued in relation to other branches of science. He referred to widespread criticism from various quarters of the level reached by science students. He considers that the fundamental cause of this criticism is the overloading of the syllabus. An important step in redressing this state of affairs has recently been made in the setting up of advisory committees containing representatives of the teaching associations and some of the examining bodies. These committees, including one dealing with mathematics, have recently approved various proposals with regard to the scholarship syllabuses, and it is hoped that a general co-ordination of the Higher Certificate syllabuses and the scholarship syllabuses will become an established fact.

Dr. F. C. Powell referred to the genuine feeling existing among university teachers that the time has come to make changes in co-operation with the schools. The new advisory committees would certainly prove valuable in this work. He proceeded to an analysis of some of the points where difficulty has been experienced in practice in making a 'clean joint' between school and university work, and welcomed the appearance of differential equations and other parts of the proposed syllabus which would help to eliminate these difficulties.

Mr. C. G. Nobbs reviewed the proposed syllabus in considerable detail and answered certain points raised by previous speakers. He showed how the syllabus has been developed logically from the idea of functionality, and how various parts of the usually accepted mathematical course have been omitted, not because they are not interesting or even useful, but because they do not fit in with this central idea. He referred to the omission of geometry as being occasioned principally by considerations of time. He hoped the syllabus would not prove too long and that members would give it a trial.

A large number of members took part in the subsequent discussion, which in the main favoured the new proposals, especially in the 'ordinary' part of the syllabus. A number of speakers referred to the question of undue length, especially for girls. The view was expressed that the advanced syllabus might be abbreviated by a reasonable system of alternatives.

The final paper of the meeting was given by Mr. W. Hope Jones, in his usual entertaining style, the subject being "More Mathematical Geography".

At the business meeting of the Association, Mr. C. O. Tuckey was elected president for 1944 and the other officers were re-elected. The Council's report showed that the Association has well maintained its membership and is in a sound financial condition. Reference was made to the excellent work of Prof. T. A. A. Broadbent in maintaining the standard of the *Mathematical Gazette* in spite of paper restrictions and other war-time difficulties. A full report of the proceedings will be given, as space permits, in that journal.

CONTROL OF TYPHUS

RECENT references in the daily Press to the appearance of typhus in eastern Europe have prompted a number of questions. What risk is there of outbreaks of typhus among British troops abroad, or of its introduction into Great Britain? What risks will there be of outbreaks of typhus in Europe after the War? Articles in the medical Press show that the whole problem of typhus is being considered all over the world; for typhus is always a serious matter, whether nations are at war or at peace.

At the present time, of course, British troops are contending with an outbreak of typhus in Naples, which has (*Brit. Med. J.*, Feb. 5, 1944, p. 205) become so serious that it is a potential menace to military operations. So far it is confined to civilians. Immunization by serum has been organized, and some 70,000 civilians a day are being treated for infestation with lice. The outbreak began under German occupation, and has increased since the German destruction of the gas and water supplies, and as a result of

overcrowding with refugees and others. It is evidently being vigorously attacked.

Some of the risks run by British troops in the Middle East are indicated by abstracts in the *Bulletin of War Medicine* and by an article by two R.A.M.C. officers, Lieut.-Colonel W. Brockbank and Major S. R. F. Whittaker (*The Lancet*, Jan. 29, p. 150). According to these authors, although the incidence of typhus is high among civilians in some parts of the Middle East, only sporadic cases have occurred so far among troops there. They describe ten cases, all of whom were British soldiers, which they treated between March and May, 1943. They direct attention to the fact that the early symptoms of typhus may be so like those of malaria, sand-fly fever, relapsing fever or typhoid that a diagnosis when the patient reports sick may be very difficult. The patient may stay for some days in a general ward in a hospital before the diagnosis can be made. Actually eight out of the ten cases described remained in a general ward until the rash of typhus fever appeared on the fifth or sixth day of the illness. The diagnosis was made more difficult by the fact that evidence of the presence of, or contact with, lice was present in only one of the ten cases. Fortunately, no cross-infection occurred. The mortality-rate from typhus is higher in patients more than thirty years old, so that the authors recommend that no personnel older than this should be detailed for duties likely to expose them to contact with typhus. Further, all personnel likely to come into contact with typhus are now given typhus vaccine. The efficacy of the typhus vaccines has been questioned, but Dr. J. B. Penfold, of the Emergency Pathological Service Laboratory, Billericay, reports (*Brit. Med. J.*, Jan. 22, 1944, p. 114) on tests made with a Cox vaccine prepared in Toronto from a European louse-borne strain of *Rickettsia prowazeki*. He vaccinated 23 public health workers with this, and found that the reactions to it were generally slight and local, and that vaccination produced an increase of the agglutination titres in most cases. Drs. Bardhan, Tyagi and Boutros, of No. 12 Field Laboratory, M.E.F., have reported (*Brit. Med. J.*, Feb. 19, 1944, p. 253) on the glass-slide agglutination test for the rapid diagnosis of typhus, modified by them for general use. They urge further trials of this method to establish conclusively the degree of its reliability.

Typhus risks in Europe are discussed by Dr. Yves Biraud, of the Epidemiological Service at Geneva (*Bull. Health Org. League of Nations*, 10, No. 1; 1943. See *The Lancet*, May 15, 1943, p. 620, and the fuller abstract in the *Bulletin of War Medicine*, 3, No. 10, 567; 1943). Dr. Biraud says that typhus has increased in Poland and the Balkans to a disquieting, but not to an alarming, degree since the outbreak of the War. Sporadic foci have also appeared in Germany and Hungary in areas which have been free from the disease; presumably these have been brought from the Eastern front. We may compare this with the outbreaks in German troops of another disease not prevalent in Germany before the War, namely, trichiniasis, which has occurred in Norway and on the Eastern front. Sporadic foci of typhus have also been found in central and southern France; but almost all the cases in these areas have been people arriving from North Africa, where the disease is always present. Bad economic conditions, such as those which resulted from the fall of France, increased its incidence in North Africa. It is not surprising that the incidence in 1941 was more than twice that recorded for any of the preceding twenty years, and that the 1941 figures were exceeded in the early months of 1942.

Typhus in Iran was the subject of an address by Col. Faruqi, I.M.S., to the recently formed Anglo-Iranian Medical Society (*Brit. Med. J.*, Dec. 25, 1943, p. 820). Last year, said Col. Faruqi, typhus killed many people and he feared a much more serious epidemic. He explained that there are plenty of medical men with wide experience of typhus now in Iran, but suggested the formation of a committee to control preventive work and to co-ordinate information.

In Spain the typhus epidemic of 1908–9 stimulated intensive study of the treatment and prevention of the disease. An account of the modern methods now being used in Madrid is given by Prof. Clavero del Campo, director of the National Institute of Health, and Dr. Perez Gallardo in a monograph entitled "Técnicas de Laboratorio en el Tifus Exantemático". This is an official publication of the Dirección General de Sanidad, Madrid, and was published in 1943. To it the director-general of health, Prof. J. A. Palanca, contributes an introduction which outlines the measures taken against these two epidemics and indicates the areas invaded by the disease. After the epidemic of 1908–9, he says, sporadic cases occurred in Spain until the epidemic of 1941–42 began. While it is as yet too early, he thinks, to claim that the latter epidemic has been conquered, it has been controlled. His account of the difficulties encountered and the measures taken shows that full advantage is being taken of the experience of specialists in other countries and of the experience gained by Dr. Gallardo when he was sent to laboratories in Germany, Poland and elsewhere. Such difficulties as the destruction by war of the National Institute of Health and the modern Rockefeller Virus Department might have daunted any but the most persistent and enthusiastic workers.

In another paper Prof. Clavero and Dr. Gallardo give the results of their work on a strain of *R. prowazeki* originally isolated and cultivated by the Cox technique on chick embryos by Dr. Snyder in 1941, and on a variant of this strain which has lost its pathogenicity, yet has retained its immunizing power (*Revista de Sanidad e Higiene Publica*, Madrid, June 1943). In further papers they report on their work on Giroud's intradermal test for typhus infection (*ibid.*, Dec. 1942) and on their investigation (*ibid.*, May 1943) of 384 rats and 62 fleas in Madrid, from which they conclude that a murine virus does not exist in the rats of Madrid. They discuss the errors which may arise from the presence in rats of various bacterial infections (*Salmonella enteritidis*, *B. alcaligenes broncho-septicus*, Spirochætes, etc.). We have already referred to the work of other Spanish medical men on typhus in some of the Latin-American countries: in Venezuela, for example (NATURE, Jan. 8, 1944, p. 51), and Bolivia (NATURE, Feb. 5, 1944, p. 162). The existence of endemic typhus in Bogotá, Colombia, is reported by Prof. Luis Patiño-Carmago (*Rev. de la Facultad de Medicina, Bogotá*, 11, 503; 1943), who claims that eight strains of the Rickettsia type have been found in various parts of Colombia. The pages of this journal and of the *Boletin de la Oficina Sanitaria Panamericana* show that typhus is being carefully watched and combated throughout Latin and North America.

Finally, reference may be made to an annotation in *The Lancet* (May 1, 1943, p. 562) which discusses the precautions taken against the entry of typhus

into the British Isles. Control depends on the control of the head or body louse infected with *R. prowazeki*, on prompt isolation of patients and contacts, delousing, disinfection of both the premises of the patients and the contacts, and on other measures which can only be carried out effectively by specially trained personnel. These personnel must be themselves protected (by protective clothing, vaccination, etc.). In England such mobile anti-typhus squads were formed some time ago. The shortage of nursing personnel made it difficult to provide suitable people for this duty, because they must be young (see above); but plenty of volunteers were available. At the same time, many authorities earmarked suitable sections of isolation hospitals for possible typhus cases. Such measures as these, combined with the strict watch which is kept at ports of entry and on aeroplanes, indicate that the risk of the entry of typhus into the British Isles is not being neglected. G. LAPAGE.

FORTHCOMING EVENTS

Friday, April 28—Sunday, April 30

INSTITUTE OF INDUSTRIAL ADMINISTRATION (at the Waldorf Hotel, Aldwych, London, W.C.2). Conference on "Management and Society".

Saturday, April 29

BRITISH RHEOLOGISTS' CLUB (at the Shirley Institute, Didsbury, Manchester), at 10 a.m.—Discussion on "Elastic Behaviour of Textile Materials".

ASSOCIATION FOR SCIENTIFIC PHOTOGRAPHY (at the Caxton Hall, Westminster, London, S.W.1), at 2.30 p.m.—"Photography as a Tool in Agriculture" (Papers will be read by Dr. E. N. Crook and Mr. V. Stansfield, and by a Representative of the National Institute of Agricultural Engineering).

PHYSICAL SOCIETY (at the new Clarendon Laboratory, Oxford), at 2.30 p.m.—Prof. Joel H. Hildebrand: "The Liquid State" (Twenty-eighth Guthrie Lecture).

Monday, May 1

SOCIETY OF ENGINEERS (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Mr. R. H. Bound: "Aircraft Hydraulic Equipment".

INSTITUTION OF ELECTRICAL ENGINEERS (CAMBRIDGE AND DISTRICT WIRELESS GROUP) (at the Technical School, Cambridge), at 5.30 p.m.—Mr. C. R. Stoner and Mr. R. W. Wilson: Discussion on "Training for the Radio Industry".

Tuesday, May 2

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield 1), at 6.30 p.m.—Mr. J. S. Ridges: "The Work of the Iron and Steel Control".

Wednesday, May 3

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Scientific Papers.

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.15 p.m.—Silver Jubilee Commemoration Meeting.

Thursday, May 4

INSTITUTE OF PHYSICS (ELECTRONICS GROUP) (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Mr. L. G. Grimmett: "The Electrostatic Generator, its Development and Prospects".

INSTITUTION OF ELECTRICAL ENGINEERS (INSTALLATIONS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. W. N. C. Finch and Mr. F. Lynn: "The Design and Performance of Domestic Electric Appliances".

Friday, May 5

GEOLOGISTS' ASSOCIATION (at the Geological Society of London, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Mr. A. S. Kennard: "The Crayford Brickearths".

APPOINTMENTS VACANT

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

LECTURER IN THE MECHANICAL AND CIVIL ENGINEERING DEPARTMENT—The Registrar, Technical College, Sunderland (May 5).

SECRETARY (temporary) of the Department of Agriculture—The Acting Registrar, The University, Leeds 2 (May 6).

Permanent BIOLOGIST (male or female) in the Public Health Department—The Medical Officer of Health, Town Hall, Luton (May 8).

EDUCATIONAL PSYCHOLOGIST (full-time), and a PSYCHIATRIC SOCIAL WORKER (full-time)—The Director and Secretary, Education Offices, Brettenham Road, Edmonton, London, N.18 (May 8).

TECHNICAL OFFICER to advise on questions of cropping and manuring of arable land and the management of dairy stock—The Secretary, Berkshire War Agricultural Executive Committee, 1 Abbot's Walk, Reading (May 8).

LECTURER (full-time) IN ELECTRICAL ENGINEERING at the Lancaster Technical College—The Director of Education, High Street House, Lancaster (May 8).

PRINCIPAL OF THE BLACKPOOL AND FYLDE TECHNICAL COLLEGE—The Director of Education, 3 Caunce Street, Blackpool (May 8).

DRUMMOND PROFESSORSHIP OF POLITICAL ECONOMY—The Registrar, University Registry, Oxford (May 13).

UNIVERSITY READERSHIP IN CHEMICAL PATHOLOGY tenable at University College Hospital Medical School—The Academic Registrar, University of London, at Richmond College, Richmond, Surrey (May 15).

LECTURER IN SCIENCE AND ELEMENTARY ENGINEERING SUBJECTS—The Principal, County Technical College, Worksop, Notts. (May 15).

ENGINEERING INSPECTOR OF MINES (temporary) in a Government Department—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.2088A) (May 17).

W. H. COLLINS PROFESSORSHIP OF HUMAN AND COMPARATIVE PATHOLOGY—The Secretary, Royal College of Surgeons of England, Lincoln's Inn Fields, London, W.C.2 (July 31).

SENIOR LECTURESHIP IN THE DEPARTMENT OF METALLURGY of the University of the Witwatersrand—Dr. W. Cullen, 4 Broad Street Place, London, E.C.2 (July 31).

CHIEF ENGINEER AND GENERAL MANAGER of the Gloucester Electricity Undertaking—The Town Clerk, Guildhall, Gloucester.

GRADUATE LECTURER IN ELECTRICAL ENGINEERING at the Southend-on-Sea Municipal College—The Chief Education Officer, Education Office, Warrior Square, Southend-on-Sea.

LECTURER (full-time) IN MATHEMATICS—The Registrar, Municipal College, Portsmouth.

LECTURER (temporary) in MECHANICAL ENGINEERING—The Principal, Handsworth Technical College, Golds Hill Road, Handsworth, Birmingham 21.

PHYSICIST to the Newcastle-upon-Tyne National Radium Centre—Dr. A. W. Sanderson, Secretary of Newcastle-upon-Tyne National Radium Centre, Royal Victoria Infirmary, Newcastle-upon-Tyne.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Institution of Mining and Metallurgy. Memorandum to the Ministe of Reconstruction on the Production of Non-Ferrous Metals and Minerals other than Coal in Great Britain. Pp. 12. (London: Institution of Mining and Metallurgy.) [243

Imperial Institute. Annual Report, 1943, by the Director, Sir Harry Lindsay, to the Board of Governors. Pp. 62. (London: Imperial Institute.) [44

Boron and Plant Life. Part 5: Developments in Agriculture and Horticulture, 1940–42. By A. C. Dennis and Dr. R. W. G. Dennis. Pp. 38. (St. Albans: Boron Agricultural Bureau.) [44

Conditions for Industrial Health and Efficiency. Pamphlet No. 2: Absence from Work; Prevention of Fatigue. Pp. 20. (London: H.M. Stationery Office.) 3*d*. net. [54

Ministry of Health and Department of Health for Scotland. Venereal Disease: Guide for Practitioners working under the Provisions of Ministry of Health Circular 2226 and Department of Health for Scotland Circular No. 50/1941. By L. W. Harrison. Pp. 20. (London: Ministry of Health.) [114

Other Countries

University of California Publications in Zoology. Vol. 46, No. 7: Two New Subspecies of Kangaroo Rats (Genus Dipodomys) from Southern California. By Jean T. Boulware. Pp. 391–396. 25 cents. Vol. 48, No. 2: Systematic Review of the Chipmunks (Genus Eutamias) of California. By David H. Johnson. Pp. 63–148+plate 6. 1 dollar. (Berkeley and Los Angeles: University of California Press; London: Cambridge University Press.) [313

The Aborigines—'so-called'—and their Future. By Prof. G. S. Ghurye. (Gokhale Institute of Politics and Economics, Publication No. 11.) Pp. xvi+232. (Poona: Gokhale Institute of Politics and Economics.) 8 rupees; 16*s*. [44

Society of Biological Chemists, India. Annual Review of Biochemical and Allied Research in India. Vol. 13 for 1942. Pp. xiii+101. (Bangalore: Society of Biological Chemists, India.) 3 rupees; 6*s*. [44

Bulletin of the Illinois Natural History Society. Vol. 22, Art. 2: Studies of North American Plecoptera, with Special Reference to the Fauna of Illinois. By T. H. Frison. Pp. iv+235–356. 1 dollar. Vol. 22, Art. 3: Management of Small Artificial Lakes, a Summary of Fisheries Investigations, 1938–1942. By George W. Bennett. Pp. iv+357–376. Vol. 22, Arts. 4–5: The Prairie Chicken in Illinois, by Ralph E. Yeatter; Preferential Rating of Duck Food Plants, by Frank C. Bellrose, Jr., and Harry G. Anderson. Pp. iv+377–434. Vol. 22, Arts. 6–7: Survey of the Illinois Fur Resource, by Louis G. Brown and Lee E. Yeager; Illinois Furbearer Distribution and Income, by Carl O. Mohr. Pp. vi+435–538. (Urbana, Ill.: Illinois Natural History Society.) [44

National Research Council of Canada. Modern Plotting Instruments. By R. Ruedy. (N.R.C. No. 1170.) Pp. 96+10 plates. (Ottawa: National Research Council of Canada.) 1.50 dollars. [54

Catalogues

Scientific Centenaries in 1943 and 1944, Books from an Astronomer's Library, Documents and Instruments, History of Photography. (Catalogue 4.) Pp. 36. (London: E. Weil.) 2*d*.

The vacancies advertised in these columns are available only to applicants to whom the Employment of Women (Control of Engagement) Orders, 1942-3, do not apply.

UNIVERSITY OF LIVERPOOL

FACULTY OF ENGINEERING

Dean: Prof. R. G. Batson, M.Eng., A.K.C., M.Inst.C.E., M.I.Mech.E.

Prospectus and full particulars may be obtained, on application to the Registrar, of Courses designed for Students desiring to qualify as Mechanical, Electrical, Civil or Marine Engineers, as Naval Architects or as Metallurgists and Metallurgical Engineers.

THE UNIVERSITY OF LIVERPOOL

The Council invites applications for the post of ASSISTANT LECTURER (GRADE III) in the Department of INORGANIC AND PHYSICAL CHEMISTRY, at an initial salary of £350 per annum. If engaged in National Service, the person selected will not be required to take up the appointment until released from his present duties. Applications, together with the names of three referees, should be sent to the undersigned as soon as possible.

STANLEY DUMBELL,
April, 1944. Registrar.

BRIGHTON TECHNICAL COLLEGE

Principal: W. MANSERGH VARLEY, M.A., D.Sc., Ph.D.

Applications are invited for the post of LECTURER IN ORGANIC CHEMISTRY in the above College. The vacancy arises through the appointment of the present Head of the Chemistry Department (Dr. G. E. Watts) to the Principalship.

The work will include the teaching of Organic Chemistry up to Honours Degree standard. Salary, according to Burnham Technical Scale, with allowances for research, teaching, and industrial experience.

Forms of application may be obtained from the undersigned and should be returned not later than May 4, 1944.

F. HERBERT TOYNE,
54 Old Steine, Brighton. Education Officer.

BRIGHTON TECHNICAL COLLEGE

Principal: W. MANSERGH VARLEY, M.A., D.Sc., Ph.D.

Applications are invited for the post of VICE-PRINCIPAL of the above College, which will shortly become vacant through the appointment of the present Vice-Principal (Dr. G. E. Watts) to the Principalship. The post will be embodied with that of HEAD OF THE CIVIL ENGINEERING AND BUILDING DEPARTMENT, and applicants should be graduates who are Corporate Members of the Institution of Civil Engineers, with experience of constructional work and teaching experience in a University or Technical College. Salary £600-£25-£700, plus War Bonus, at present £52 p.a. Further particulars and forms of application may be obtained from the undersigned, and should be returned not later than May 4, 1944.

F. HERBERT TOYNE,
54 Old Steine, Brighton. Education Officer.

UNIVERSITY COLLEGE OF SWANSEA

The Council invites applications for the post of LECTURER in the Department of MATHEMATICS. The salary will be determined according to qualifications and experience, with a minimum of £400 and a maximum of £500 per annum. The appointment will date from October 3, 1944.

Further particulars may be obtained from the Registrar, University College, Singleton Park, Swansea, by whom applications must be received on or before Saturday, May 20, 1944.

EDWIN DREW,
Registrar.

NEWCASTLE-UPON-TYNE NATIONAL RADIUM CENTRE

Applications are invited for the post of PHYSICIST to the Newcastle-upon-Tyne National Radium Centre.

The salary will be up to £800 per annum according to experience.

Applications should be sent to Dr. A. W. Sanderson, Secretary of Newcastle-upon-Tyne National Radium Centre, Royal Victoria Infirmary, Newcastle-upon-Tyne.

UNIVERSITY COLLEGE, LEICESTER

Applications are invited for the post of LECTURER in Charge of the Department of BOTANY. Salary £500 per annum with participation in the Federated Superannuation System for Universities. Duties to commence October 1, 1944. Applications to be sent not later than May 27 to the Registrar, from whom further particulars may be obtained.

MINISTRY OF LABOUR AND NATIONAL SERVICE

OVERSEAS EMPLOYMENT.—CHEMISTS required for service with petroleum company in the Middle East. Training up to B.Sc. standard. Salary £30 to £40 per month according to qualifications and experience. Meals and furnished quarters provided, also thrift fund and other benefits. Age 20 to 35. Applicants should write, quoting F.1843XA, to the Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2, for the necessary forms which should be returned completed on or before May 17, 1944.

UNIVERSITY OF LONDON

The Senate invite applications for the University Readership in Chemical Pathology tenable at University College Hospital Medical School (Salary £950). Applications (10 copies) must be received not later than first post on Monday, May 15, 1944, by the Academic Registrar, University of London, at Richmond College, Richmond, Surrey, from whom further particulars should be obtained.

THE UNIVERSITY OF MANCHESTER

Applications are invited for the post of LECTURE-ASSISTANT IN MATHEMATICS. Stipend £300 per annum. Duties to commence June 25, 1944. Applications must be submitted not later than May 13, 1944, to the Registrar, the University, Manchester 13, from whom further particulars may be obtained.

THE UNIVERSITY OF SHEFFIELD

The Council of the University invite applications for the CHAIR OF BOTANY, about to become vacant owing to the appointment of Prof. W. H. Pearsall, F.R.S., to the Quain Chair in University College, London. Salary £1,000 per annum plus wartime allowances. The successful candidate will be required to enter upon his duties on October 2, 1944. Applications should reach the undersigned (from whom further particulars may be obtained) by June 1.

W. M. GIBBONS,
Registrar.

Vacancies exist in the Research Laboratories of a well-known company, situated in the North Midlands, manufacturing synthetic resin and rubber products, for two science graduates. Candidates who are taking their final examination during the present year will be considered. A knowledge of metallurgy will be an advantage for one vacancy. Salary according to age and qualifications.—Apply, giving fullest details (which will be treated confidentially), together with copies of three testimonials to Box 180, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

B.Sc. (Horticulture) desires responsible scientific position in vital enterprise. Practical experience commercial food production; experimentation; scientific translations. Preferences: Pathology and control, genetics. Allied sciences considered. Box 185, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Laboratory Assistant wanted for boys' Public School—modern science block. Applicants state salary required and give references. —Apply, Headmaster, St. Albans School, Abbey Gateway, St. Albans.

B.Sc. Woman Chemist, 2 yrs. Industrial research experience, desires post in London, preferably on staff of technical journal, or suitable administrative position. Box 186, T. G. Scott & Son, Ltd., 9 Arundel Street, London W.C.2.

Export: Managing Director established New Zealand distributors, visiting England shortly, desires contact Manufacturers binoculars and Cameras and Associated lines. Buying Agencies required now. Substantial orders can be placed immediately manufacturing facilities available.—Write Sawell, 4 Ludgate Circus, London, E.C.4. Central 4353.

Research Fellow (Biochemist) required. —Applications, with full particulars to Secretary, Research Institute, 117 Grove Street, Liverpool, 7.

Disbanding Research Laboratory, Colorimeter, balance electric centrifuge, drying bath, various glassware, refrigerator and Hearsons insulator.—Dr. Annis, Chesswood Road, Worthing.

Microscopes, of all descriptions, only a few available second-hand, perfect condition. Send details of your requirements enclosing 3d. stamp.—Chards, Microscope Specialists, Forest Hill, S.E. 23.

VETERINARY EDUCATIONAL TRUST

FORTHCOMING ELECTIONS TO POSTGRADUATE FELLOWSHIPS AND UNDERGRADUATE SCHOLARSHIPS

In pursuance of its purpose to stimulate the advancement of veterinary education and research, the Council of the Veterinary Educational Trust will shortly proceed to elect the undermentioned Fellows and Undergraduate Scholars:

A second **Junior Wellcome Fellowship** to promote research applicable to the advancement of veterinary science.

Two **Cooper Centenary Fellowships** to promote research, preferably in animal parasitology.

The above are open to applicants under 36 at election, holding R.C.V.S. Membership Diploma or any British Empire University degree (or, if female, having equivalent qualification by examination). Value, £450 p.a. subject to income tax. Tenable for 1 year, extended to 2–3 at discretion of Council.

Five **Ranks' Blue Cross Undergraduate Scholarships** and five **Spillers' Undergraduate Scholarships.** Open to applicants of either sex, under 18 on October 1st, 1944, or ineligible for military service, who have matriculated or have taken the Higher Schools Certificate. Value, £200 p.a. Tenable for 5 years at any Veterinary School affiliated to R.C.V.S., subject to reports of satisfactory progress.

Election to all the above fellowships and scholarships will be made in June and takes effect from October 1, 1944. Application forms from Hon. Sec., Educational Grants Committee, Veterinary Educational Trust, 40 Westminster Palace Gardens, London, S.W.1. Stamped and addressed foolscap envelope must be enclosed. Applications must be received on or before May 21st, 1944.

STUDENTSHIPS

Five **Evans Final Year studentships,** provided by Messrs. Evans, Sons, Lescher and Webb, Ltd., will be awarded at the end of current session, to take effect from October next, to student at head of Fourth Year Class in each of the five Veterinary Schools affiliated to R.C.V.S. Value, to cover final year's tuition and examination fees and certain books.

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