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RECONSTRUCTION AND SOCIAL SECURITY

THE full significance of the Beveridge report is only becoming apparent as its place in general reconstruction policies is appreciated. Already the report has brought the phrase 'freedom from want' out of the abstract into the concrete, and in doing so, as an article in the American periodical *Fortune* shows, makes a contribution to Anglo-American solidarity that should not be underrated. "We believe that it is possible, and therefore desirable, for the Government to set a minimum below which employment and the national income will not be permitted to fall. . . . Such a policy would in effect guarantee the existence of a job for every man who wants and is able to work. We do not think that the American voter will settle for less, and we see no reason why he should be asked to."

In the conditions or assumptions upon which Sir William Beveridge bases his Plan for Social Security, its linking with an all-embracing public health service and a national and international policy to maintain employment, he is clearly in line with tendencies in the United States which were foreshadowed in President Roosevelt's speech on "The Four Freedoms" two years ago, as the reception of the Plan outside Great Britain testifies. Already the report has put into our hands a weapon for political warfare of the first importance, when once the Government has recognized the opportunity and matched it with a series of social measures such as would restore the faith of the ordinary man throughout the world in the power of democracy to answer the imperious needs of a new age.

The exigencies of the war situation are therefore a reason not for delay but for action on the report. Sir William Beveridge, in the closing passage of his report, urges the importance of his proposals, or other proposals covering the same ground, as an aid to victory. His prescience has been brilliantly vindicated by the reception of the report abroad, the universal recognition of the connexion between the Beveridge Plan and the Atlantic Charter, and the acceptance of the report as a concrete effort to apply our principles and give a lead in building a world for the greater happiness of the ordinary man. There may be modification in detail, but there can now be no casting aside of the report without breaking faith. Action is imperative, and while it is right that there should be full deliberation over the proposals, procrastination would be a peril to the common cause as well as to ourselves.

Emphatically the first need is for decision as to the acceptance of the principles involved. This is the first step to be taken, before the detail of preparing the necessary legislation and bringing the scheme into being ready for the end of the War can be undertaken by some person or body appointed for that purpose. Decisions as to the rates of benefit and contribution can be left until the probable level of prices after the War is better known.

What is true in this question of the prevention of want is no less true of other aspects of reconstruction.

The prevention of want and the prevention of idleness, as Sir William Beveridge emphasized in his lecture to the Fabian Society, are distinct problems, needing distinct solutions. None the less, they are related problems, and the Beveridge report has the further merit that it places the whole question of reconstruction in its right perspective and calls for action all along the line in the attack on the five giant evils of physical want; of disease, which often causes want and brings other troubles in its train; of ignorance, which no democracy can afford among its citizens; of squalor, which arises mainly through the haphazard distribution of industry and population; and of idleness, which destroys wealth and corrupts men. Statement of a reconstruction policy by a nation at war is statement of the uses to which that nation means to put victory, when victory is achieved. In a war which many nations must wage together as whole-hearted allies, if they are to win victory, such a statement of the uses of victory may be vital.

Sir William Jowitt's speech, like that of Mr. Eden, in the recent two-day debate in the House of Commons on reconstruction, afforded some further evidence that the Government has fully in mind the wide range of problems involved, but the debate was chiefly of interest for its indication of a general sense that it is high time for general discussion to crystallize in terms of policy. Mr. Attlee has since affirmed the Government's resolve not to return to a scarcity economy, but to base policy on the utilization of abundance, and, in particular, has pledged the Government to an attack on the four great problems of unemployment, housing, social security and education, in the last of which, he said, investigations have reached an advanced stage. What is required, however, is decision on questions that determine policy. Of some of the vast territories on the map of the future which Sir William Jowitt and Mr. Eden endeavoured to unfold in response to Mr. Greenwood's appeal, a few, like those covered by the Barlow, the Beveridge, the Scott and the Uthwatt reports, have been fully explored. Others are now being explored by committees more or less well qualified and more or less adequately equipped. The recommendation of the Beveridge report for a further immediate investigation of the finance and organization of medical services with a view to the establishment of a comprehensive health and rehabilitation service is an example of other fields as yet marked out only in the broadest outline. The urgent need everywhere is to press forward the work of inquiry and, where this has been completed, for the Government to take clear and authoritative decisions of policy.

It is at this point that the Government's inaction is disquieting. The announcement of a new Ministry of Town and Country Planning is a decision to create machinery, not a decision of policy, and ill conceals a reluctance to reach a decision on the most important recommendations of the Uthwatt and the Scott Committees and the Barlow Commission. Again, there is a hesitant note about recent pronouncements on education, which the decision practically to suspend arts courses in the universities of Great Britain will emphasize. Further, the Beveridge report removes the last reason for delaying a decision on family allowances.

First among the decisions of principle now or soon required from the Government are clearly those on physical reconstruction and development of rural and urban Britain, on the integration of social services, and on education. In regard to these, it may well be argued as further reason for urgency that, though there may be division of opinion as to method, there can be little as to objectives. There is vital work to be done on which there is no controversy on Party lines. Whole towns, for example, must be reconstructed because the enemy has left no option, civic life has to be restored and strengthened, and the mobilization of peaceful industry to be achieved with the demobilization of the defence forces and war industries. These are obligations laid upon us by the impact of war, and they will summon for their discharge a spirit of public service which is the pride of all Parties and the monopoly of none.

The failure to implement sound planning on the lines lucidly and cogently recommended by impartial experts of unimpeachable qualifications, as in the Uthwatt report, or to allow them to be whittled down by the mere fear of action on a scale commensurate with the need, is to miss a great opportunity. Every social advance entails, and always has entailed, an adjustment of private interests to the requirements of public interest.

The interdependence of domestic and external policies, though it must be kept carefully in mind, for freedom from want cannot be achieved in isolation, either from attack on the other problems emphasized by Sir William Beveridge, or from other nations, must not be an excuse for procrastination or indecision. A world economic survey in this field would assuredly yield valuable results in the assessment both of want and of available supplies, a matter in which the Allied Post-War Requirements Bureau is only covering a part of the field. There need, however, be no delay in taking the decisions on policy and the establishment of the machinery and the preparation of legislation while the final facts determining the level of need and contribution are being ascertained.

There can be no doubt as to the value of general confidence that the Government had effective plans for maintaining employment after the War, and would use all the powers of the State, so far as necessary, for that purpose. That confidence, as Sir William Beveridge rightly insists, would be in itself a major contribution to victory, and nothing could more surely engender that confidence than the demonstration in those fields where the exploratory work is complete that the Government is ready and determined to act. As Mr. Greenwood rightly observed, it is the Government's business to lead and to make proposals for the future which honourably fulfil, so far as within its power, the promises that have been made. There can be no sheltering behind a smoke-screen of non-controversy. The test must be, not whether proposals or policy are controversial, but whether they are necessary and desirable in the national interest.

It is true that there must be frank and balanced recognition of all the elements demanded in a collective national effort. The Social Security Plan, for example, may have repercussions on our export trade which must be considered, as was frankly recognized by Sir William in his notable address before the Fabian Society. Maintenance of employment, upon which the success of a social security scheme depends, is the most urgent, important and difficult of reconstruction problems. Methods of solving it must be agreed and settled during the War. The demobilization plans of the Government must include not merely dealing with the armed forces and converting the war industries to peace production, but also a great development of export trade to pay for the food and raw materials which used to come as payment of interest on our overseas investments and for our shipping services. National planning and direction in the use of our resources are also essential. Both capital and labour, as Sir William Jowitt emphasized, must be more fluid, and barriers of custom, trade union rights and property rights which hinder the use of national resources in the way most urgently needed must be abolished.

In the execution of the plan it will be vital to preserve initiative and enterprise. The practical problem is that of discovering how to combine the proved benefits of private enterprise at private risk in the past with the necessity of national planning in the aftermath of War. That problem can only be solved by thorough and impartial investigation, and we may well hope that it will not be neglected by the committee appointed to formulate detailed proposals on the organization of industry to which reference is made in the recent statement, "A National Policy for Industry". Moreover, any further extension of Government activity in the economic field clearly involves reconsideration of the machinery and methods of government, including both the central organization and the Civil Service. We must face the possibility that for new jobs we may require a new type of official and a new organization. Sir George Schuster suggested in the reconstruction debate that we may need to develop a new career of what might be termed industrial statesmanship. There are already great industrial organizations which provide places for men of this type, but men of like calibre and experience are required on the Government side, who understand industrial processes and trade and yet are in a position to see the tasks and problems from the point of view of the Government as representing the whole community. Sir William Beveridge's own suggestion was for an Economic General Staff.

The question of the democratic institutions by which the organizing power of the Government can be integrated with the driving force of individual enterprise is one of the fundamental problems that confront us, and none makes more searching demands on lucid and intrepid thinking. There can be no quarrel with Sir William Jowitt's statement that the Government is surveying industry by industry because the structure of industry will not fit into a common mould. Different methods of co-operation and control may well be developed for different industries, but while the exact methods by which Government control and planning are to be exercised for particular situations require investigation and consideration, it is imperative that there should proceed simultaneously on the Government side an overhaul of the whole machinery of Government, including not merely the structure, recruitment and adequacy of the Civil Service as an instrument of modern government, but also of the ministerial and cabinet responsibilities and relations which are involved.

Those wider and fundamental considerations, rather than departmental interests or sectional views, should determine the choice of the machinery to be used in planning; between, for example, the recommendations of the Barlow Commission and the Scott and Uthwatt Committees. That is the least satisfactory feature of Sir William Jowitt's announcement of the establishment of a Minister of Town and Country Planning. Such a Ministry may, it is true, develop ultimately into the wider Ministry required to ensure full co-ordination and the formulation and execution of an adequate national policy. There is, however, nothing to indicate that the decision is based on a full examination of the structure of the Government machine, rather than on a desire to gain time and meet an embarrassing demand for action, as the successive changes of policy in this matter of planning might suggest.

It is well that there should be no hasty steps which might prejudice the establishment of machinery and institutions best adapted to serve the needs of the whole nation, and to reconcile the virtues of freedom and initiative with the order and discipline inevitable in a measure of planning. There must be timing in our planning: education is only one sphere where this is all-important. Democracy cannot seize the full opportunities which the War has opened up without fundamental and constructive thinking on these issues. Meanwhile, however, there is plenty of room for action to secure the ground required for further advance, to prevent obstruction by sectional interests and privileges, and to work out the technical and administrative details of the measures required to give effect to a national policy aimed at securing freedom from want and from unemployment, a programme for health and education, and the elimination of the squalor which arises through haphazard distribution of industry and population or the waste and abuse of resources or amenities. Wide though the range of Sir William Jowitt's survey, welcome as may be his remarks on housing, welfare and nutrition, agriculture, forestry, water supply, electric power supply and education, he said little to indicate that the Government has reached the stage of decision and action. Words alone will no longer satisfy the country as to the Government's earnestness in the matter, or fulfil the hopes and expectations which the Beveridge report and the speeches of Government spokesmen both in Great Britain and in the United States have already aroused. There can now be no turning back. The Beveridge Plan is not the only one which points to courageous simplification with

great savings in administrative costs and in efficiency at the centre. From scientific workers as from other members of the community comes the demand that the Government shall match both the opportunity and its own declarations with decisions and administrative and legislative acts worthy of the cause in which we contend. They would be as inspiring to the nation in its war effort as the implementing of a social security policy would assuredly be in giving strength and a renewed impetus to the cause of the United Nations.

NORTH-WEST AFRICAN PREHISTORY

The Prehistoric Archæology of North-West Africa
By Frederick R. Wulsin. (Papers of the Peabody Museum of American Archæology and Ethnology, Harvard University.) Pp. xii + 173 + 12 plates. (Cambridge, Mass.: Peabody Museum, 1942.) 3 dollars.

THIS is a book some of us have been wanting for a long time. From the prehistorian's point of view, north-west Africa is an extremely interesting region, and until now information about it could only be obtained in 'bits and pieces', often in articles which were difficult to come by. It is true that the author does not pretend to have visited the area he deals with, still less to give the results of his own excavations in the field; but he has examined most of the available literature critically, and as a result has pieced together a consistent account of the whole subject. A certain school of thought has grown up recently which appears to consider that no publication can be of much worth which does not give the results of personal excavations and investigation in the field. Those who take this view perhaps forget that their own results will necessarily have to be utilized by future researchers in the same way as Mr. Wulsin has used his sources, and their findings similarly subjected to critical study.

That the final conclusions given in this book will be universally accepted in their entirety is, of course, unlikely—indeed there are a number of alterations which will probably have to be made—but none the less the whole collects together conveniently a mass of information and will form the basis for all future discussion on the prehistory of this area.

The opening chapter sets the stage for the ensuing work from its environmental point of view. The area is defined and the climate, both present and prehistoric, considered; and it is interesting to note that apparently there has been little climatic change since Roman times. There follows a chapter on the Lower Palæolithic sequence. Here the author seems to accept the possibility that some of the *coup de poing* industries found on the surface in this area could be of much later date than their equivalents in western Europe (p. 13). But surely it is not so much the similarity in the shape of tools, ranging from South Africa to western Europe, that matters, impressive as is this fact alone; the point is the similarity in the evolution of the industries in these far-flung areas. Yet such an evolution took place under diverse conditions, and different materials were used for fashioning the tools. Surely this similarity in the evolution of the industries argues for more or less of similarity in date. Should there have been any great time lag, the different conditions in the different areas would have given rise to different developments. Indeed it would seem to me that there must actually have been slow cultural interpenetrations—like the movements of molecules in a liquid—which helped to give rise to the uniform developments that we find.

The relationship between the Lower Palæolithic industries and the geological changes as shown by strand lines is next considered. Here the author accepts Vaufrey's conclusion that no pleistocene bridge existed across the Mediterranean. If this were really so, north-west Africa would certainly have been, as suggested, rather a backwater than a highway—though none the less interesting for that—and communication between Africa and Europe would, until later times, have been almost entirely through Syria. One ventures to wonder whether this question is quite certainly settled. The author's tentative dating of the Chellean to a Mindel-Riss interglacial phase is, I think, probably incorrect. The industry at El Hank on subsequent investigation appears to be mixed Chelleo-Acheulean, and it would surely seem more likely that the true Chellean is contemporary with the final stages of the 90 m. shore-line and thus Gunz-Mindel in age—a correlation which agrees with the results of investigations in the Somme valley.

In his chapter on industries and their variants, the author deals with the middle stone age which, as always in Africa, is difficult to pin down and presents a number of variations. I wonder whether it is wise to use the term Mousterian until it has been definitely proved that Neanderthal man lived in the region and made these industries? But this question involves a definition of the term Mousterian. Mr. Wulsin uncompromisingly classes the Aterian as a Mousterian with one new tool, the tanged point. Actually tanged points have been found in Mousterian levels both in Jersey and at La Ferrassie. But surely the true Aterian is more than that. Among other types occurring, what about the points with thinning flaking on their under surfaces? That the Aterian has middle stone age traditions is undoubted, but can one not see later stone age contacts present? Its date, anyway, would seem to be late middle stone age. A chapter on the Upper Palæolithic follows next. Here a distinction is made between the Capsian culture and the Oranian culture, which has a rather different distribution. Both develop into Neolithic industries. One of the troubles in this southern region is the lack of the distinctive and drastic climate changes which give rise farther north to clear-cut distinctions between the various cultures. In Africa a culture, and the fauna too, just tend to continue on and merge into the succeeding culture, even when this latter is really mainly due to migration from outside the region and not to simple evolution of the predecessor.

Mr. Wulsin, naturally, does not discuss the problem as to whether there is any cultural connexion to be seen between the early Upper Palæolithic of north-west Africa and the Perigordian of western France; this would have made an intriguing digression. In passing, one can note a misprint on p. 81, where the word Caspian appears instead of Capsian in the table. Chapters on the Neolithic and early historic periods follow. There is still, of course, much work to be done on the desert pottery. It is unfortunate that many of the results obtained by

the Wellcome and the Mond investigators still remain to be published. A most interesting chapter (illustrated) on the rock-shelter art follows. The author seems to accept Vaufrey's view that the drawings are Neolithic. It would seem, however, probable that an earlier rock-shelter art existed in the region, and that some of the drawings belong to this earlier date and culture. The Grotte d'in-Ezzan lies outside the region under review, but the earliest paintings there do form a link between the earliest art in Southern Rhodesia and that of eastern Spain. The latter is certainly in part older than the Neolithic. Finally, there is an excellent résumé on the skeletal finds and a general conclusion. A useful appendix on the prehistoric mammals of Algeria is given, and an excellent bibliography concludes the work.

The whole volume is lucidly written and well got up and misprints are rare ; indeed with the exception of the 'Caspian' for 'Capsian' already noted there are none which are immediately obvious. Mr. Wulsin has done an excellent piece of work which will notably lighten that of all future investigators of north-west African prehistory. M. C. BURKITT.

THE COUNTRYSIDE AS IT WAS

Country Ways

By Esther Meynell. Pp. v+152. (London : Chapman and Hall, Ltd., 1942.) 12*s*. 6*d*. net.

Field Fellowship

By H. J. Massingham. Pp. 192+16 plates. (London : Chapman and Hall, Ltd., 1942.) 8*s*. 6*d*. net.

ENGLAND was last swept by a wave of faith during the Victorian era. Men worshipped wholeheartedly at the shrine of progress and were so intent on their end that they scarcely had time to notice the means they were employing. Then came the great reaction against this boundless faith and optimism. Men could not help noticing the consequences of their work : the dark factory filled only with gloom, machinery and hands ; the slums and the slag-heaps that littered the countryside ; and the appalling intellectual poverty of the bulk of the population. The city dweller, seeking ways of overcoming these blots of civilization, looks forward to an era of light and airy factories and homes built of modern materials if need be, glass, modern alloys and brightly coloured plastics, with gas and electricity as sources of light, heat and power.

The literary country dweller tends to take the opposite view. Seeing the slum, the slag-heap, and the soulless factory, he longs for the time before these existed, the era of the medieval village, the wood fire and the village pump ; the era in which change, if it came at all, came extremely slowly. Village life was hard but satisfying, devoid of doubt or change, where every good workman was a craftsman and extremely proud of his craftsmanship. There were no mere mechanical machine minders in those days nor any leisure for such passive occupations as cinema-going. These two books, in their different ways, both describe this way of life, both seeing the village through rose-tinted glasses.

Mrs. Meynell's book describes country life as it was, illustrating her story with well-chosen quotations from contemporary authors. She is unashamedly parochial—her countryside is Sussex—but the book gains in vividness by this rigid geographical limitation. She knows her authors well and quotes sympathetically from many hitherto neglected. It is one of the most charmingly written of country books, and will delight every lover of the countryside.

There are only a few statements to which exception can be taken on grounds of scientific accuracy. Her statement that "the principle of ploughing—which is the inversion of the soil—remains the same, however eagerly man seeks after many inventions" is certainly not valid in the semi-arid regions. The ploughs used in the Middle East, which probably antedate the European by several millennia, have no mouldboard and only break up the surface of the soil without inverting it. The cause of the dust bowls in America and elsewhere is in part due to the unfortunate use of the European instead of the Asiatic plough. It cannot be due, as she suggests, to the use of artificial fertilizers, which are not used there owing to lack of water.

Mr. Massingham's book is a collection of articles about various aspects of country life. The longest section gives an admirable account of village architecture, showing in detail how sensitive the village builder used to be to the inherent qualities of his local material, and how his buildings displayed these qualities. Then there is a very sympathetic essay on W. H. Hudson which does full justice to his memory.

In the remaining thirty-seven short articles Mr. Massingham is an unrepentant longer for the past. What seems to be wrong, he says, with English village life is that it has changed since the seventeenth and eighteenth centuries, and almost every change has been for the worse. He writes appreciatively and with knowledge about old customs and trades, and so scathingly about modern ones that he is not concerned too much with mere scientific accuracy. Thus he is very fond of wholemeal bread, and sees, to his dismay, that the inhabitants of his village eat, in peacetime, white bread baked from white flour that has been milled in a large roller mill situated at a port. What easier than to accuse the big millers of encouraging people to want to eat white bread. Yet Drummond and Wilbraham pointed out in their book that people were clamouring for white bread a full century before the 'big business' miller and the roller mill. Parliament tried several times in the eighteenth century to make people buy a good nutritious standard loaf, but the clamour for white bread continued, though it was more expensive and the whiteness was often obtained by using alum and perhaps other adulterants.

The picture of the countryside to-morrow need not be so black as Mr. Massingham implies. Mechanization of agriculture means using machines to do work previously done by hand, but it does not necessarily mean cultivating 1,000 acres with 100 horse-power tractors. To-day the corn ranch can be mechanized, and there is no reason why a mixed dairy farm of 100 acres and small fields may not be as completely mechanized in the future, though the dairy herd could, and probably would, receive as much personal care as in the past.

Mr. Massingham naturally deplores the loss of ancient crafts in the villages that followed the introduction of the factory, but he seems to have overlooked the new crafts now being acquired. The village garage mechanic is often a superb craftsman, but he uses steel, the oxy-acetylene torch and the power-driven lathe instead of iron and the treadle lathe of his ancestors. But that makes him none

the less as genuine a craftsman as the village carpenter, though his workshop may smell of oil rather than of wood shavings.

These two books serve the valuable purpose of emphasizing that village life had an unhurried simplicity and gave a contentment to its inhabitants that is frequently lacking at the present time. One of the great problems for the future is to fuse this essential completeness of village life with the intellectual ferment so characteristic of the present time. Few would willingly wish to retain the intellectual stagnation that was too often a characteristic of village life in the past. E. W. RUSSELL.

FOUNDATIONS OF ASTRONOMY

Foundations of Astronomy

By Prof. W. M. Smart. Pp. vii+268. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1942.) 16*s*. net.

PROF. W. M. SMART needs no introduction as a writer of astronomical books. These range from popular accounts such as "The Sun, the Stars and the Universe" to his valuable and comprehensive work "Stellar Dynamics", dealing with the movements of the stars.

The work now under review falls in the gap between popular descriptions of astronomy and general text-books for university students, such as the standard "Text-book on Spherical Astronomy" by the same author, now in its second edition. "Foundations of Astronomy" is intended for students taking a first-year course in astronomy in the universities and for all those interested in the subject who feel the need for a more solid foundation than the many descriptive books can provide. The author hopes also that the book will be of value to the many young men in the naval and air forces, who are required to have some knowledge of astronomy in its application to navigation as an introduction to the Service manuals in which greater emphasis is laid on technical matters.

Commencing with chapters on "The Geometry of the Sphere" and "The Celestial Sphere", the book gives definitions of most of the astronomical terms, accompanied by full and careful explanations, which will be found simple to follow, and by illustrative examples. A prominent feature in these explanations is the use of appropriate diagrams, well thought out and produced. Along with these definitions there occur many descriptions and explanations of natural phenomena which will be found illuminating. It is worth noting that the spherical trigonometry used is made to depend on one formula only—the cosine formula—and that this dependence is direct in each case.

Although the astronomy is mainly positional, the chapter on "The Stars" includes a brief introduction to the spectrum and to some of the important and fascinating results which may be obtained by studying the constitution of the light from the stars. A chapter on the "Determination of Position on the Earth" is also included.

A useful feature is the inclusion of a number of examples for the student at the end of nearly every chapter, together with a collection of answers at the end of the book. Appendixes give tables of astronomical constants and the elements of the planets and the satellites, and the book possesses a useful index.

The work is beautifully printed and shows very little evidence of war-time production.

A few minor misprints and obscurities have been noted, but only one seems likely to cause confusion; in section 138, on the "Heights of Lunar Mountains", it should be noted that only a particular case is concerned, when M is on, or very near, the moon's equator (incidentally, Y is not a cusp).

"Foundations of Astronomy" as a whole gives a simple and adequate account of astronomical terms and usage; further, it is at the same time just a little more than a bare text-book in that it describes rather more phenomena than are needed to explain the definitions. The mathematical attainments of the student are carefully considered, as is indicated by the use of asterisks to point out sections which may be omitted from a first reading, and by the very careful explanations, particularly in the more elementary parts—the true "Foundations".

J. C. P. MILLER.

DRAINAGE OF OIL WELLS

Oil Well Drainage

By Dr. Stanley C. Herold. Pp. xv+407. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1942.) 30*s*. net.

PETROLEUM technologists, especially on the production side, will be familiar with the author's "Analytical Principles of the Production of Oil, Gas and Water from Wells", published in 1928—a severely mathematical treatise of a complex subject. Reviewing that volume the writer stated at the time that it was "unquestionably a remarkable effort for one man and nothing quite like it has appeared before in the annals of petroleum literature". The same can be said of this, Dr. Herold's latest work. This time it is the story of oil well drainage shorn of mathematics (except in a brief appendix) but replete with recorded incidents and observations skilfully interpreted in terms of what is unseen in natural oil reservoirs. The basis of this work is primary analysis of any particular North American oilfield by reference to a questionnaire of twenty-one questions (introduction) to which appropriate answers, where they can be given, are collated and resulting data segregated according to whether the oilfield is Palæozoic or Cenozoic.

This division into "older" and "younger" constitutes a twofold classification governing considerations of reservoir energy; the function of natural gas; radius and area of drainage; regional drainage and water encroachment; drainage across property lines; effects of stratigraphy and structure on drainage; effects of reservoir penetration on drainage; effects of multiple zones on drainage; effects of rates of production on drainage; effects of field development on drainage; drainage by wells of all or no gas; injection of gas, water or oil; reservoir content, ultimate recovery and reserves; abandoned oil and gas; curtailment, proration and conservation.

There are always snags in any attempt at simplification of highly variable functions, especially of fluids like petroleum and natural gas. For example, oil wells drawing from Tertiary deposits may simulate Carboniferous or older formational types of production and *vice versa*. The admittedly rarer instances of Mesozoic oil may possess production characteristics of either Cenozoic or Palæozoic pools; the author apparently sees no reason to suspect a third type of

production peculiar to Mesozoic formations, but he does not neglect such possibilities. Another interesting point: two types of production provide two types of drainage and, according to the author, where an oil well at any specified time of its life is producing exclusively to the pattern of one type of production, its reservoir is subject to only one corresponding type of drainage and there is no compromise between the two types. But conditions may alter within the reservoir when the well may change its production and drainage pattern from one type to the other.

This is admitted, but surely it does complicate the issue considerably; whether such change can always be detected from performance of the well or behaviour of reservoir, as suggested by the author, is a debatable point, especially, for example, in the case of production from multiple sand lenses embedded in clay, for example, Trinidad.

Although this book deals essentially with the physical features of production and drainage, the mathematical basis or proof for the theses submitted is constantly in the background and one feels that the period 1928–1941 has, by increased experience in many fields, served rather to confirm than to amend the author's earlier analytical results. In fact, in a delightful preface, he acknowledges James Perrin Smith's advice to him to tell the story "in simple language and do not fail to cite the field examples of drainage that you will have found". This has been done and done well, in a volume of some four hundred pages, thirty-six line diagrams of oil fields and relevant subjects heading the chapters, and in an easy, informal, conversational style that in no way detracts from the masterly grip Dr. Herold obviously has of a subject he has made very much his own.

Whether the profusion of small-type marginal notes throughout the text, plus the use of several different point sizes, including Gothic type captions, is intended as an artistic presentation of a subject that has few of the arts and most of the sciences, is doubtful and, in these days of austerity printing, the reader may think this has been rather overdone. But no one, not even "the operators, leaseholders, landowners, attorneys at law, legal experts on contracts, politicians and governmental agents", for whom the story is told in this way, can fail to derive a measure of contentment from its unfolding; to that list may well be added the "petroleum technologist", to whatever specialized branch he devotes his ability and learning.

H. B. MILNER.

NON-SINGULAR CUBIC SURFACES

The Non-Singular Cubic Surfaces

A New Method of Investigation with Special Reference to Questions of Reality. By B. Segre. Pp. xi+180. (Oxford: Clarendon Press; London: Oxford University Press, 1942.) 15*s*. net.

THIS is a very remarkable monograph; it is a direct product of war circumstances. After a curt verification of the existence (Cayley, Salmon, 1849) of a symmetrical system of twenty-seven lines, each met by five pairs of mutually intersecting lines, the author turns to a diagrammatic representation of the lines, by the joining segments of nine points which lie in threes on three coplanar concurrent lines. This is reached by considering how the lines would vary in a continuous deformation of the surface into three planes, and, beautifully executed as they are, the various diagrams serve the author's purpose well. Actually, the representation is the dual of one considered by Bennett, in which the lines of the surface are represented by the points in which the rays of three coplanar pencils, α, β, γ, each of three rays, meet one another; in this representation a line of the (Steiner) system of nine lines, represented by the intersection of a ray b of the pencil β, with a ray c of the pencil γ, meets the four lines indicated by the intersections of the other rays of these two pencils, and meets the six lines indicated by the intersections of b and c with the rays of the pencil α. This law of intersection is unaltered by the interchange of the rays of a pencil among themselves, or by the interchange of the pencils.

It can be shown that there are forty ways of arranging the twenty-seven lines in such three associated Steiner systems, indicated by the intersections of three pencils of three rays. Thus there are 40×6^4, or 51,840, ways of arranging the twenty-seven lines among themselves so that all intersections persist. The *group* of operations which effect these arrangements is also obtained by the author by combining the thirty-six transpositions of the lines of the various double sixes; his discussion involves a masterly exposition of the relations among the lines. He shows, too, as Burnside had shown, that the group can be generated by combining only six such transpositions. He does not refer to Coxeter's conclusion that the group can be generated by combining one such transposition with a single cyclical change of nine tritangent planes, containing the lines of three associated Steiner systems.

In pursuance of his main object, the author next obtains the five Schläfli types of real surfaces, $F_1, \ldots, F_5$, with, respectively, 27, 15, 7, 3, 3 real lines (the last type consisting of two pieces). However, to study the groups of possible interchanges of the lines of these various types, many distinctions of character are considered for the lines. A real line is elliptic or hyperbolic, according as the involution on the line, arising from the tangent planes through it, has imaginary or real foci; and hyperbolic lines are of two kinds. An elliptic line is right- or left-handed according to the direction of rotation of the tangent plane through it, as the point of contact moves along the line. An imaginary line is (in von Staudt's phrase) of the first or second kind. All these, and other distinctions, must be preserved in the allowed exchanges of the real and complex lines of the surface, the aggregate of which constitutes the group. The result of a complicated discussion is that the respective orders of the groups of the real surfaces are 60, 36, 4, 24, 24.

After this the author proceeds to the consideration of the regions into which the real lines divide the surface. He computes, with an interesting examination of the shapes of the various regions, the number $r = 2 - \alpha_0 + \alpha_1 - \alpha_2$, wherein α_0 is the number of intersections, or corners, of the regions, α_1 is the number of segments, each terminated by two corners, and α_2 the number of regions; and finds the values of r for the respective types of real surfaces to be 7, 5, 3, 1, 1. A remark is possible in regard to these numbers: For the surfaces F_1, F_2, F_3, there exist double sixes of which one half consists, respectively, (1) of six real lines, (2) of four real lines and two conjugate complex lines, (3) of two real lines and two pairs of conjugate complex lines. If we compute the number r for a (projective) plane, using the joining lines of 6 (or 4, or 2) real points therein to determine the

regions (with two other lines in the last case) we obtain $r=1$. But, if we make holes in the plane, bounded, say, by circles the centres of which are at the 6 (or 4, or 2) points considered, the values of r for the desiccated plane will be 7 (or 5, or 3). The suggestion of Cremona's representation of the cubic surface on a plane is obvious.

The last chapter of the volume, largely algebraical, is devoted to Sylvester's representation of the equation of the surface by the cubes of five linear functions. It is shown that there are two types only, of non-singular surfaces, which cannot be thus given by five (or fewer) cubes, but that these are given by six cubes. One type, with vanishing discriminant, requires seven cubes. The author also applies Sylvester's form to obtain the five types of real surfaces, distinguishing between them by inequalities among the coefficients multiplying the five cubes.

It will be seen from this skeleton survey that the book is one for which, for long years, the reader will be grateful to the author—and to the Clarendon Press.

H. F. BAKER.

HIGH-SPEED COMPRESSION-IGNITION ENGINES

High-Speed Diesel Engines

With Special Reference to Automobile and Aircraft Types; an Elementary Textbook for Engineers, Students and Operators. By Arthur W. Judge. Fourth edition, revised and enlarged. Pp. vii+536+45 plates. (London: Chapman and Hall, Ltd., 1941.) 25*s*. net.

THAT a fourth edition of this book has been published only eight years after its first appearance shows that it meets a demand. The author has compiled a vast and valuable fund of information and has been very well supported in the presentation of this matter by the publishers. The greater is the regret that the author has not found it possible to reduce the number of errors and to avoid presenting, as in many instances, incorrect pictures of various aspects of his subject. To assist the student—and also the author in preparing a new edition—the following points are mentioned.

In the development of high-speed compression-ignition engines, extending over nearly twenty years, it is inevitable that many designs of combustion chamber and of injection equipment should be put forward and for various reasons afterwards dropped. In his preface, the author explains that he has retained many of these "in view of their historical interest". This would be well justified if he had indicated those designs that are obsolete and those which continue to be built; but the reader is left in complete ignorance on this distinction.

A similar vagueness surrounds many of the technical and experimental subjects treated by the author. Views of writers of scientific papers are often quoted or embodied in the text, the references and dates of the papers being usually quoted; but the value of these would be greatly enhanced, and a more accurate presentation given, if the author, after suitable analysis, had stated which of these had proved, in the light of later evidence, to be incomplete.

Some of the errors relating to combustion chambers are as follows: on p. 140, the statement appears that the Lanova combustion chamber was produced by the inventor of the Acro combustion chamber "acting in co-operation with F. Lang". This is misleading, but is nevertheless true, since Lang was the inventor of *both* combustion chambers. On pp. 143 and 144, reference is made to the Omo and the Oberhänsli combustion chambers, and the latter is said "to resemble the Omo". They are one and the same, the designer being the Swiss engineer, Oberhänsli, while the company controlling the commercial development is the Omo A.G., of Zurich. The M.W.M. design on p. 120 is given as a modified type of Acro combustion chamber: while it is similar, it was the result of independent development. A modification was, however, actually made by the Saurer company to the Acro design, by giving a 'cross-stream' motion to the air. The author attributes this modification to a designer, "Kreuzstrom" by name.

Contrary views are often given without suitable analysis, following the method of compilation adopted by the author. For example, the picture of the initiation of combustion presented on p. 94 differs from that on pp. 99 and 100. In discussing the influence of injection advance on ignition lag, on pp. 101 and 102, the author, near the bottom of p. 101, reaches the conclusion, given in italics: "the ignition lag will therefore be greater as the injection is advanced". On p. 102, he goes on to give the results of tests by Dicksee which, with one design of combustion chamber, confirm this and, with another, contradict this conclusion. This is followed by the correct conclusion that the result also depends on the combustion chamber; but this is not given in italics by the author, and a reader taking a cursory glance at the passage would be completely misled. If, however, the author had analysed the subject and had correlated the results with Bird's work in Fig. 53, or better with Wolfer's later work at Cambridge with Bird, which is not mentioned, a correct picture would have resulted.

On pp. 179 and 181, the author refers to the excellent pioneer work of Taylor and Hawkes at Farnborough, reported in Taylor's paper in 1927, and writes, with italics: "Another interesting point observed was that *as the torque was reduced, so was the specific fuel consumption*". Although slow-running compression-ignition engines had revealed such characteristics near full-load, this may have been a striking result in 1927 for a high-speed unit, but the author himself, notably in Figs. 15, 33, 263 and 297, shows that this has long been recognized as the normal characteristic of compression-ignition engines. This is a typical fault of compilation.

Errors and slips in references are numerous, and the following may be mentioned: p. 69, 1926 p. 555 for 1932, p. 685; Figs. 40 and 44 are obviously from the same reference but are not acknowledged; p. 36, 1831 for 1932; p. 169, 1931–32 for 1934, while Fig. 124 is from this reference but not acknowledged. 'Junkers' is usually given as 'Junker'.

Many of these are minor matters to those who have read widely in the subject; but in a work described on the title page as an elementary text-book for engineers, students and operators, they become of vital importance. Reference to the numerous original papers is difficult for such readers, and the responsibility of the author is great. It is to be hoped, therefore, that in the fifth edition which will certainly be called for, the author will convert his work from being merely good to superlative.

S. J. DAVIES.

AN INTERNATIONAL ANTI-LOCUST CAMPAIGN

By DR. B. P. UVAROV

Anti-Locust Research Centre,
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AS an outcome of a series of intensive investigations carried out during 1930–38 by entomologists of several nations on a common plan, practical schemes for the preventive control of the three species of African locusts were formulated[1]; but the outbreak of the War in 1939 made the postponement of schemes, which were of necessity international in character, apparently inevitable.

Efforts to save the situation, however, were continued and full credit is due to the respective Governments for establishing two of the three projected organizations, although on a necessarily restricted scale. The organization for the control of the Red locust (*Nomadacris septemfasciata*), with headquarters at Abercorn, Northern Rhodesia, came into existence in 1940 and is now a joint British-Belgian undertaking. Its field work is progressing, and regular patrolling of the outbreak areas has already been organized.

The original outbreak areas of the African Migratory locust (*Locusta migratoria migratorioides*) are on the middle Niger in the French Sudan. Since swarms of this locust, if allowed to spread, would overrun the greater part of the African continent, the organization for the prevention of its outbreaks was planned as a French one, but supported financially by all the countries concerned. The isolation of French West Africa made the fate of this plan very uncertain, and considerable anxiety was felt in other countries of Africa that a new outbreak of the Migratory locust might develop on the Niger unchecked. It was, therefore, welcome news to learn that a "Centre du surveillance antiacridien" has been established on the Niger, as a purely French organization, though its work is certain to benefit a number of other countries.

No details are available as to whether the organization is sufficiently strong and extensive to cope with any emergency; but in any event its existence means that the beginning of the outbreak will not pass unnoticed. In fact, reports have come through that some signs of renewed activity of the Migratory locust were observed last spring on the Niger, but that the first incipient swarms have been destroyed. In view of this news, an effective strengthening of the French organization would be in the direct interest of the whole of West Africa, Equatorial Africa, Belgian Congo and all East African countries from the Anglo-Egyptian Sudan down to Southern Rhodesia, Mozambique and Angola.

The third species, the Desert locust (*Schistocerca gregaria*), presents the greatest difficulty from the point of view of its preventive control. The western region of its invasions comprises the drier zones of West Africa, Morocco, Algeria and Tunisia, and the investigation of its outbreak areas in that region had not been completed when a new invasion commenced in 1940; at present the invasion is fully developed and requires measures for direct control of swarms on a large scale. The eastern region of the Desert locust extends from India, through Persia and Arabia into Eastern Africa and the Sudan. Some of the original outbreak areas here have been discovered, and an organization for their preventive control should have come into operation in 1939–40, but the proximity of the war zone made this impossible. As a result, the first swarms had a chance to develop unchecked, and at present the Middle East, India and East Africa are faced with the prospect of repeated invasions during the next two to three years. The production of food and fodder is of considerable importance to the Allied war effort, since local shortage would have to be replaced by importation, with consequent extra demands on shipping space. Hence an anti-locust campaign had to be organized throughout the threatened countries.

Studies on the seasonal migrations of the Desert locust, carried out by the Anti-Locust Research Centre during the last twelve years, have shown that the whole region from India to East Africa forms an interconnected migration area. Swarms bred during summer monsoon rains in India move in the autumn to southern Persia and Arabia; the latter country receives at the same time swarms bred during the summer monsoon in Africa. Some of the invaders breed in southern Persia and Arabia, and in the following spring swarms move to the borders of Soviet Middle Asia, into Iraq, Transjordan, Palestine, Syria, Sinai and Egypt, where a spring generation is produced; later in the season there is a dispersal of swarms westwards to East Africa and eastwards to India for subsequent breeding in the summer monsoon rains.

The existence of such extensive movements of swarms makes it futile for each country to attempt its own isolated control operations, as has been the practice in the past, when a united anti-locust policy had little chance against the isolationist tendencies. Paradoxically, war conditions have removed many difficulties and have made it possible to organize, not a dozen small campaigns aimed merely at the defence of crops in each country, but the development of a single plan embracing all the countries involved and assuming the character of offensive operations. The plan aims at the extermination of locust swarms not only where they represent an immediate danger, but also in the desert areas where they may be harmless locally but represent a potential threat to other countries.

A campaign of this kind should be based on exact and timely information with regard to the movements of swarms, and special efforts have been made to improve and enlarge the existing locust information service. The present conditions have made possible its extension to areas which used to be inaccessible, so that now the developments in the whole region can be fitted into a single picture on which forecasts of expected movements can be based. It is a point worth mentioning that, during the present locust outbreak, no country has been invaded without receiving a timely warning from the Anti-Locust Research Centre, whereas in the past the invasions happened unexpectedly and defence measures had to be improvised in haste, with disastrous consequences.

In planning the campaign it was necessary, first of all, to take into account that in several of the countries concerned there exist efficient local entomological organizations. Such organizations in Egypt, Palestine, the Sudan and Kenya have undertaken to act as local centres for collecting information, while they also render great services to all surrounding countries by the preparation of poison bait and by

the training of native technical personnel. The Anglo-Egyptian Sudan, with its model anti-locust organization, has naturally become a most important base and a training ground, not only for the technical staff who are sent to the 'locust control school' from other countries, but also for the newly appointed locust entomologists.

The second group of countries comprised those with anti-locust organizations of their own, but with resources insufficient for large-scale operations. War conditions have made it difficult to obtain, for example, poison for baits, and supplies had to be acquired in bulk and distributed where they were needed, while reserve stocks were laid down at conveniently situated bases. In the case of Persia, outside assistance with regard to supplies, however, did not solve the difficulty. Southern Persia was expected to become this winter an important, probably even the main, concentration area of swarms, and this forecast is being fulfilled. The local Persian entomological organization would be adequate in a normal year, but it was clearly impossible to expect it to deal unaided with the present emergency. Moreover, the immediate importance of locusts in the sparsely populated and little cultivated areas of southern Persia is much less than their threat to India, Soviet Middle Asia and the whole of the Middle East where they may spread next spring. On the other hand, such concentrations of swarms throughout the winter and subsequent breeding in early spring make southern Persia a convenient ground for large-scale operations designed to reduce the number of swarms available for invasions. These considerations led to the organization of a joint campaign in which Persian, British, Soviet and Indian experts are working side by side according to a single plan and pooling their resources.

Finally, there are some countries where there exist no organizations capable of undertaking locust operations. To leave them out would mean creating sanctuaries for locusts where they would breed undisturbed and then move in vastly increased numbers to more fertile regions. In this respect, the vast peninsula of Arabia represents a problem in itself. It has been established that over-wintering of swarms and their breeding in early spring occur in Arabia on a large scale, but that in late spring practically the whole peninsula is evacuated by swarms which spread to the surrounding countries, including eastern Africa. From the local point of view, locusts are scarcely of any economic importance, the population being largely nomadic, but the interests of other countries demanded the inclusion of Arabia in the general plan of campaign. The only part of the peninsula where operations could be organized by the local Government is Aden and its protectorates, where some assistance was needed only as regards supplies and technical personnel. Elsewhere, everything must be done by special motorized parties led by experts. Again, as in Persia, the collaboration of several countries has made this possible, and a plan has been prepared according to which several of the most suspected areas will be covered by the British, Egyptian and Indian parties. Very scanty information with regard to the interior of Arabia and obvious difficulties of work in such a country make this part of the campaign somewhat hazardous, but even if the immediate practical success is incomplete, valuable experience will be obtained for use in the next campaigns.

Ethiopia required special treatment. Owing to its geographical position it plays an important, but still very imperfectly understood, part in the seasonal migrations of locusts. Practically no data on this subject were available before the Italian occupation, and the short period of Italian rule coincided with the clear interval between the two outbreaks of the Desert locust. Therefore, it was essential, from the general point of view, both to ensure that the breeding of locusts and the movement of swarms in Ethiopia should not remain unknown, and to endeavour to introduce modern control methods into local use. A special anti-locust mission has been sent to Ethiopia, and its first aim is to create an efficient locust information service, as well as to demonstrate modern methods of control, and to train local technical personnel which may form the nucleus of an Ethiopian anti-locust organization. The work of the mission is proceeding with a considerable measure of success, and this large and important blank in the maps of locust movements in Eastern Africa is now being filled.

Such are the scope and the aims of the present anti-locust campaign in the Middle East and East Africa. Its general direction, requiring the close collaboration of many Government Departments, is in the hands of an Interdepartmental Committee on Locust Control at the Colonial Office, while the technical and the scientific side, including the planning of operations, is directed by the Anti-Locust Research Centre, under Sir Guy Marshall. The British experts who have been specially engaged for the liaison work between different countries and for directly conducting operations where this is required, form a Middle East Anti-Locust Unit, attached to the Middle East Supply Centre, which makes the necessary administrative arrangements for the provision of transport, the procuring of supplies, their distribution, etc.

With the campaign still in its initial stages, it may be too early to say whether the organization just outlined will prove to be adequate to meet the situation, which is certain to become increasingly serious. However, preparations have been made while the outbreak is only developing, and the first season should show whether any modifications are needed to meet the peak of the outbreak expected to be reached in 1943–44.

In these times, when the possibilities of planned application of scientific knowledge on a scale unrestricted by national considerations are attracting general attention, the present anti-locust campaign may constitute a useful test case. Four features of the campaign should be of general interest. First, the campaign has assumed its international scope quite naturally, because the situation could not have been dealt with efficiently on a narrow national basis. Secondly, the co-operation of the various countries concerned was obtained without difficulty, because their self-interests coincided with the common interest. Thirdly, the necessary unity of operations was achieved not by attempting to introduce a rigid central direction, which would inevitably cause friction, but by offering the co-operating countries a definite practical plan based on a sound scientific foundation. Finally, the whole organization is kept together by the demands of the work in hand rather than by formal agreements, and this makes it very flexible and easily adjusted to meet changing conditions.

[1] NATURE, 142, 174 (1938).

THE INTERFEROMETER IN LENS AND PRISM MANUFACTURE*

By F. TWYMAN, F.R.S.

THE optical system used by Michelson in his interferometer, which was applied by him to so many important purposes, has since 1917 been gradually coming into use in a modified form as a routine test in the manufacture of lenses and prisms. The various forms in which it has been used have been the subject of a series of patent applications[1] and have been described in various technical papers[2], which are of little interest except to specialists in optical manufacture. The general principles of the instrument may appeal to a wider circle and are sufficiently well illustrated by the two simplest forms called, respectively, the prism and the lens interferometer.

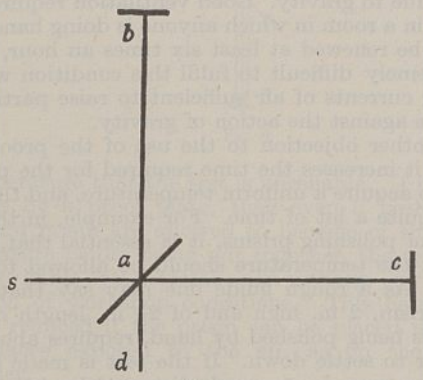

Fig. 1.

All the forms are based on the system of mirrors illustrated in the paper by Michelson and Morley (*Phil. Mag.*, 1887) and shown in Fig. 1. The effect of this system of mirrors is optically almost identical with the process of putting two flat glass plates together face to face to form Newton's colours. These are formed by interference of the light reflected

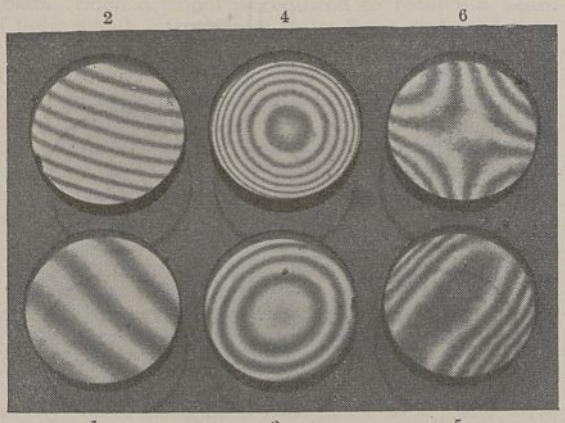

Fig. 2. APPEARANCES WITH PROOF PLATE.

1. Nearly perfect, the proof plate slightly tilted.
2. The same, but the proof plate tilted about 2½ times as much.
3. Astigmatic surface (slightly ellipsoidal).
4. Surface concave or convex, according to the colours.
5. Strongly astigmatic.
6. Astigmatic of the saddle-shaped variety, that is, concave in one direction, convex in the direction at right angles.

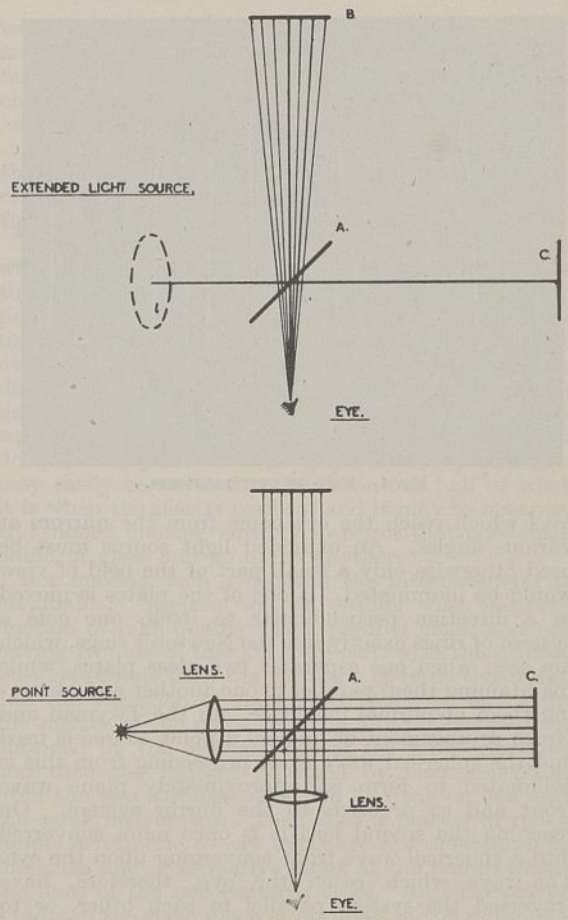

Fig. 3. DIAGRAMS OF MICHELSON (ABOVE) AND TWYMAN AND GREEN (LOWER) ARRANGEMENT.

from the two opposing surfaces, and are the same in their nature as the Newton's rings which are caused when a shallow convex glass surface is laid on a flat one. This ring system was described by Newton ("Opticks", Book 2), who was the first to find a relation between such colours and the corresponding distances apart of the surfaces.

Newton's bands have, of course, been utilized for many years, possibly for more than a century, in optical workshops, by the use of the optical proof plate. The optician has one surface which he calls the proof plate and on which he can rely as being of a standard flatness or sphericity, and he tests the flat or curved surfaces which he is making by putting the proof plate in contact with the work. Fig. 2 shows some of the appearances which may be observed.

Referring now to Fig. 1 : *sa* is a ray of light which is partly reflected from *a* to *b* and partly transmitted from *a* to *c*, the mirror *a* being lightly silvered. If the paths *ab* and *ac* are equal, an image of *b* is formed in contact with *c*, and we have the conditions optically identical with those producing the Newton's colours when two plates are placed in contact. If the position of the mirror *b* is gradually altered we shall reproduce the optical effect of separating two such plates.

In the Twyman and Green prism and lens interferometers, the Michelson mirror arrangement is modified as shown in the lower part of Fig. 3. It will be seen that in the Michelson arrangement the

* From a discourse at the Royal Institution on November 27.

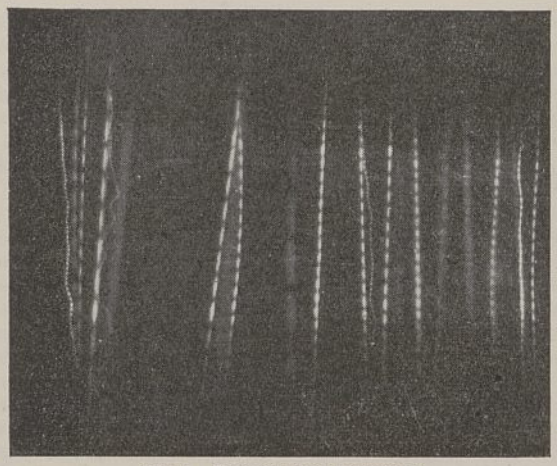

Fig. 4. FALL OF DUST PARTICLES.

rays which reach the eye come from the mirrors at various angles. An extended light source must be used otherwise only a small part of the field of view would be illuminated. If one of the plates is moved in a direction perpendicular to itself, one gets a system of rings exactly like the Newton's rings, which are seen when one separates two glass plates, while maintaining them parallel to one another and observing them at normal incidence. In the Twyman and Green arrangement of mirrors a point source is used and the spherical wave front proceeding from this is collimated to form an approximately plane wave front and so proceeds to the mirror system. On reaching the second lens it is once more converted into a spherical wave front converging upon the eye. The rays which reach the eye, therefore, have traversed the system parallel to each other, or to speak in the language of the wave theory of light, the beam of light traverses the mirror system with a plane wave front.

One part of the Michelson system has been omitted in these figures—a plate of glass of exactly the same thickness as that of the diagonal mirror. This is not necessary in the Twyman and Green instruments as used in the optical workshop, since monochromatic light is used, the light being obtained from a low-pressure mercury vapour lamp.

The simplest application of this instrument is to use it instead of a proof plate for testing the flatness of optical surfaces. To do this the mirror *c* is replaced by the object the polished surface of which it is desired to test ; for that purpose the surface must be placed on a levelling table, and on adjusting the instrument, one then sees a contour map representing the imperfections of the polished surface, it being presumed that the mirrors are optically perfect. It may be asked, why use so complicated an apparatus when we could just as well use a proof plate ? There are two objections to the use of proof plates : one is that particles of dust are always settling on the surfaces to be tested, so that no matter how carefully one cleans them there is a risk of grit being present between the proof plane and the surface to be tested. These prevent the surfaces coming close enough together to give brilliant Newton's fringes, and there is then an almost irresistible impulse on the part of the optician to attempt to force them together, with the inevitable result of causing scratches. It may be asked why, then, are precautions not taken to avoid such dust ? This is not so easy. Fig. 4 is a photograph of falling particles of emery powder in still air. The particles are illuminated by a strong beam of light which is provided by alternating current of 50 periods per second, so that there are 100 flashes of illumination per second. The exposure lasts for a long enough time for the falling particles to appear each as a discontinuous line, like a string of beads, and the distance from one of these beads to the next is, of course, the distance traversed by the moving particle in 0·01 sec.

In this way it was found that the rate of fall of emery grains of an average diameter of 0·005 cm. is 6 cm. a second, and grains of this size are quite large enough to cause very bad scratches. If now we take a similar photograph in ordinary moving air of a workshop during working hours, we find that the movement of air is such as entirely to outweigh the tendency of the particles to fall. The particles move both upward and downward, according to the eddies of the air, and at vastly greater speeds than the rate of fall due to gravity. Good ventilation requires that the air in a room in which anyone is doing hand-work should be renewed at least six times an hour, and it is extremely difficult to fulfil this condition without causing currents of air sufficient to raise particles of this size against the action of gravity.

The other objection to the use of the proof plate is that it increases the time required for the piece of work to acquire a uniform temperature, and this may waste quite a lot of time. For example, in the final stages of polishing prisms, it is essential that, before testing, the temperature should be allowed to settle down. As a rough guide one may say that a 60° glass prism, 2 in. high and of 2½ in. length of face, which is being polished by hand, requires about half an hour to settle down. If the test is made sooner, the prism may be so much distorted by inequalities

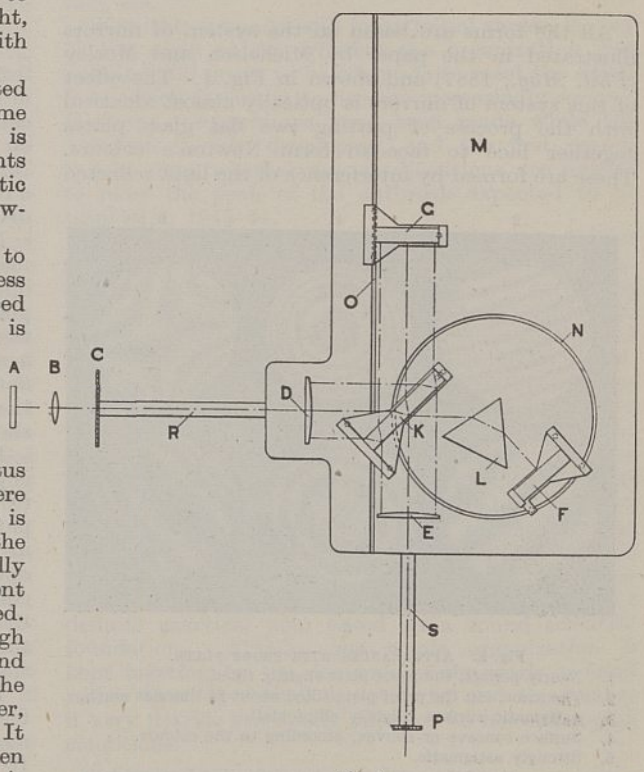

Fig. 5.

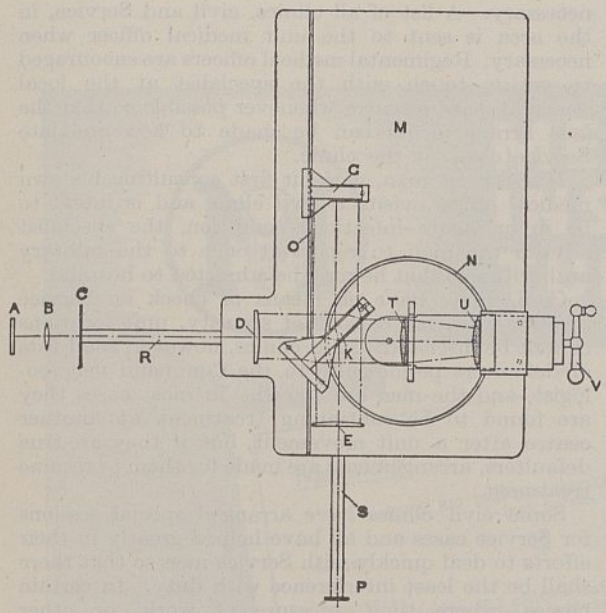

Fig. 6.

of temperature that the test is unreliable. If the test is made by a proof plate, then even if both proof plate and prism are allowed to become of the same temperature before being put together, the temperature is liable to become non-uniform owing to variation of workshop conditions. This liability is greatly reduced if the prism can be placed with all its surfaces exposed to the air, as on the interferometer.

Thus the interferometer may serve a useful purpose in replacing, on occasion, the very much simpler proof plate. This, however, is a very minor part of its use in the workshop.

All optical systems have for their purpose to receive a beam of light which originates from a point, and to alter the shape of its wave front in a predetermined way. For example: Fig. 5 shows the interferometer as arranged for testing a 60° refracting prism. Such a prism is required to receive a beam of light which has a plane wave front and to deliver it after transmission also with a plane wave front. If the wave front is distorted, whether that be due to the surfaces not being flat or the glass not being homogeneous, the appearance seen by the observer on the interferometer is an interference pattern which represents, in the form of a contour map, the aberrations of wave front produced by passage of the beam twice through the prism. We can, as it were, apply a proof plane to the wave front to ascertain how much it has been distorted by a piece of optical work.

Fig. 6 is an interferometer to which additions have been added for testing lenses. The right-hand mirror of the instrument has been removed and replaced by an optical system consisting of the lens T under test and the convex mirror U, so arranged as to send the rays back along their own path. If a plane wave falls on T, it should then, if the lens and mirror are perfect, emerge from T on its return path, still in the form of a plane wave. If it does not, we can see exactly what parts of the lens are responsible for the error and can usually, at the same time, judge quite easily from what cause the error arises.

There is a specialized form of instrument to deal with photographic lenses. Fig. 7 shows the appearances seen with a lens on the camera lens interferometer for a point off axis. The error is that characteristic of the form of aberration known as 'coma'.

The interferograms, if I may call them so, are, then, contour maps to a scale of half wave-lengths of the errors of wave surface caused by transmission through, or reflection from, the object under test.

Having observed in this way what is the error of wave front produced by an optical element, what is the optician to do about it? That depends on practical considerations. If the piece is one of a number made together in a block, he may put it back with others for re-working. But first of all it is highly desirable that he should know whether the defect is due to the glass not being homogeneous or to the surfaces being imperfect, for if he has a number to do and the glass is heterogeneous, his production may easily be reduced to less than one half of what it is when the glass is perfect; and it may be cheaper, and indeed quicker, entirely to reject that particular batch of glass and go on to another.

For making such a decision the interferometer is invaluable. Suppose we are dealing with the production of high-quality plane parallel glass, and are having trouble of this kind, we can, with the utmost ease, determine both the variation of refractive index and the variation of thickness. We map out upon the surface of the plate, first the interference pattern obtained by the ordinary use of the interferometer, and then the pattern obtained by back reflection from the two surfaces—this can be done on one and the same instrument. Then it is a matter of quite simple arithmetic to say what are the differences of thickness and of refractive index at the points where the lines of the two patterns cross. An accuracy of 5 units in the sixth place of decimals in the refractive index, and 10^{-6} in. in the thickness, can be attained in this way.

If it is the refractive index that is at fault, and there is no other glass available, the optician may proceed to correct the optical performance by retouching. With the interferometer this is an extremely simple operation—as simple as levelling a seed bed in a garden. One rubs with a rouged pad on the high places until the interference appearances show that the work is good. The interferometer tells exactly where to rub and how much.

Now to give an illustration of other uses of the instrument.

Let us suppose that two 60° angles are to be compared, one being the standard. One prism is stood

Fig. 7.

on the other, and they are placed on the instrument in place of the mirror F (Fig. 5) so that the interference fringes are obtained from both surfaces. The top prism is then tapped gently until the face under observation is parallel to that of the standard. Both prisms are now rotated so that their other faces are presented to the beam. Needless to say, this rotation must be very carefully done to avoid shifting the top prism relative to the bottom one. A slight rotation must now be given to the diagonal plane of the interferometer, in order to make the fringes on the standard horizontal. Then if there is any angular difference between the prisms, the fringes seen on the other prism will be tilted, the number of fringes cutting the horizontal separating line being a measure of this angular difference. If the interference bands are formed by the green light of a mercury vapour lamp, each band represents 10^{-5} in.

To test the 90° angle of a roof prism the side mirror F of the instrument is swung round to the right-angle position and the roof prism placed on a table of suitable height to reflect the light on to the mirror. The appearance of two horizontal bands indicates that the angle of the roof is not quite 90°. If the angle is smaller than 90°, then by pulling the telescope rod gently in a downward direction (which increases the path length of the light reflected in mirror G), the fringes will move inwards towards the dividing edge.

[1] Twyman and Green, British Patent 103832/16. Twyman, British Patent 130224/18.

[2] Twyman, F., *Phil. Mag.*, 35, 49; *Trans. Opt. Soc.*, 22, 4; *Trans. Opt. Soc.*, 24, etc.

VENEREAL DISEASE

LIAISON BETWEEN SERVICE AND CIVIL AUTHORITIES

By MAJOR J. MARSHALL, R.A.M.C.

FOR the past two years, in the treatment of venereal disease, the Services in Great Britain have had the help and co-operation of certain civil clinics. Under a scheme devised by the Ministry of Health and the Service authorities, these clinics agreed to carry out surveillance and after-treatment of Service venereal disease cases on the same lines as those used in Service hospitals and clinics. Often the use of civil clinics has meant an immense saving of time and transport in districts where there is no convenient Service venereal disease centre. The purpose of this article is to show how the scheme is working in the Eastern Command and London District.

Service men who contract venereal diseases are always admitted to a Service hospital and are treated there until they are free from symptoms, non-contagious, and fit to resume full duties. After-treatment or surveillance is carried out at the clinic, civil or Service, nearest the man's station. Before a man leaves hospital, he is given verbal instructions regarding his after-care, and his medical officer receives a proforma giving the address of the chosen follow-up centre and naming the date and time for the first appointment. If the man is to attend a civil clinic his medical officer sends with him a case record card each day he attends. On this card is a pencilled scheme of treatment for the guidance of the civil specialist. It is appreciated on both sides that this is only a guide and does not apply where the civil specialist finds that other measures are necessary. A list of all clinics, civil and Service, in the area is sent to the unit medical officer when necessary. Regimental medical officers are encouraged to get in touch with the specialist at the local venereal disease centre whenever possible so that the best arrangements can be made to accommodate Service cases at the clinic.

If a Service man, without first consulting his own medical officer, visits a civil clinic and is found to be in an acute infectious condition, the specialist advises the man to report at once to the military authorities so that he may be admitted to hospital.

Civil clinics have no means of check on Service defaulters as, for reasons of security, unit locations cannot be disclosed. Most clinics, however, send lists of defaulters periodically to the Command venereologist, and the men are traced. In most cases they are found to be continuing treatment at another centre after a unit movement, but if they are true defaulters, arrangements are made for them to resume treatment.

Some civil clinics have arranged special sessions for Service cases and all have helped greatly in their efforts to deal quickly with Service men so that there shall be the least interference with duty. In certain clinics, where time, pressure of work, or other reasons have made it difficult for the civil staff to deal with Service men, the clinic has been lent to the Command venereologist for a few hours each week, and a special Service clinic has been opened.

For men leaving the Services before treatment is completed, arrangements are made for them to continue at the civil clinics nearest their homes.

Every effort is made to bring the female source of infection under treatment. When a patient knows by whom he has been infected, he is encouraged to write to the woman, telling her of the importance of seeking medical advice, and enclosing a sealed addressed letter for her to take to the specialist at the civil venereal disease clinic nearest her home. This letter informs the specialist of the nature of the suspected disease. When his patient permits, the specialist informs the sending hospital that the woman has attended and of his findings. The number of women brought under treatment by this method has more than justified the scheme.

When dealing with marital cases it is often a great help in avoiding family upsets if the same doctor can deal with both parties. This is especially the case in those instances where a man has unwittingly exposed his wife to infection during the incubation period of one of the venereal diseases, and commanding officers are co-operating by allowing a man time off to accompany his wife to the clinic on the first visit. In this connexion the London Lock Hospital has helped by lending its female clinic for a morning each week when the Command venereologist may see Service men's wives who are resident in London. The Command specialist is able to transfer to members of the honorary staff of the hospital any special cases falling outside the province of venereal disease, such as obstetric or gynæcological conditions.

In conclusion, it may safely be said of the collaboration of the civil and Service venereal disease systems that both sides have done their best to make the scheme a success, and that the results have been most encouraging. The thanks of all concerned are due to the civil venereologists, public health and hospital authorities who have assisted so greatly in this matter.

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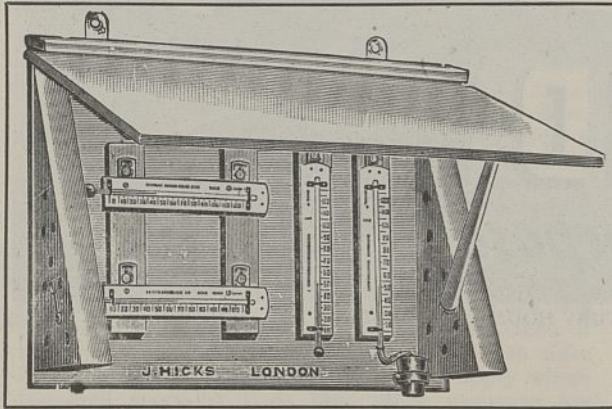

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OBITUARIES

Sir Henry Miers, F.R.S.

SIR HENRY MIERS passed peacefully away on December 10 in his eighty-fifth year at his home in West Hampstead after a fortnight's illness. A man of unusual versatility, he gained eminence as a mineralogist and crystallographer, as a university administrator, and as a museum authority. Having had the advantage of what was commoner in his day than now, a classical education, before taking to mathematics and science, he had the gift of a fluent and lucid style of writing, as is evident in his numerous publications. Despite the partial failure of eyesight which afflicted him in his closing years and restricted his activity, he maintained up to the end his interest in all the matters that had formerly occupied his attention. When reading became difficult, he took up as a hobby the study of plants.

Henry Alexander Miers came of a family that had already shown some proclivity towards science. John Miers, F.R.S., well known as a civil engineer and in his later years as a botanist, who accompanied the great seaman, Lord Cochrane, at his invitation to South America in 1818, in order to develop the mineral resources of Chile, and in the course of his travels made an extensive collection of South American plants, now in the British Museum, was his grandfather, and Edward John Miers, who was on the staff of the Zoological Department of the British Museum from 1872 until 1885, when ill-health compelled his retirement, and was an authority on Crustacea, was his elder brother. He himself was born at Rio de Janeiro on May 25, 1885, his father, Francis Charles Miers, being at that time in business there as a civil engineer.

Miers was educated at Eton College, where he was a King's Scholar, from 1872 until 1877, and at Trinity College, Oxford, where he held a classical scholarship, from 1877 until 1881. He transferred his studies to mathematics, however, and graduated with second-class honours in mathematical moderations in 1879 and finals in 1881. In 1900 he proceeded to the newly instituted degree of D.Sc.

On going down from Oxford, Miers joined the staff of the Mineral Department of the British Museum on the inducement of Mr. (afterwards Sir Lazarus) Fletcher, who was keeper, in 1882, very soon after the removal of the collection from Bloomsbury to the new building at South Kensington. He assisted in the arrangement of the specimens in the Mineral Gallery and in the preparation of the crystallographic catalogue which had been projected. As the result of his studies he published numerous articles and memoirs on the morphology of various minerals. With his museum duties he combined the post of instructor in crystallography at the Central College, South Kensington, from 1886 until 1895. He was editor of the *Mineralogical Magazine* from 1891 until 1900.

In 1895, when N. Story-Maskelyne retired from the chair of mineralogy at Oxford and the opportunity was taken to revise the post, Miers was appointed to fill the vacancy and became the first Waynflete professor, the post having been combined with a fellowship at Magdalen College. Hitherto only courses of lectures had been given, so that Miers had as his first task to effect teaching arrangements and organize laboratory work as well as improve the mineral exhibition in the University Museum. Among his earliest pupils was H. L. Bowman, who became so fascinated with the subject that he remained to assist him, and eventually succeeded him in the chair. Miers took up a task which he had in his mind for some time, namely, the preparation of a comprehensive treatise on mineralogy; it was published in 1902 ("Mineralogy: An Introduction to the Scientific Study of Minerals", Macmillan). The second edition, which appeared in 1929, was undertaken by Bowman. During this period Miers carried on the research, upon which he had been privately engaged in London, on the conditions which determined the kind of crystals formed in a saturated solution, and cleared up many obscure points.

While at Oxford, Miers soon acquired a reputation for administrative ability, and consequently, when in 1908 a successor to Sir Arthur Rücker was sought in the difficult and onerous office of Principal of the University of London, he was chosen. Although no great changes occurred during his period of office, it was in the following year that a Royal Commission was appointed under Lord Haldane's chairmanship to investigate the whole question of university education in London. It reported in 1913, but owing to the outbreak of war in the following year, nothing was then done to carry out any of the recommendations in the report. Soon after, in 1915, Miers was translated to Manchester as vice-chancellor of the University, and such success did he achieve in this office that he was pressed to remain after reaching the normal age for retirement, and did not vacate the post until 1926. It was a great pleasure to him to return to teaching by acting as professor of crystallography.

When he had finished at Manchester, Miers returned to London to live, and settled down at West Hampstead for the rest of his life. He was by no means idle: he was promptly elected a trustee of the British Museum, thereby creating a precedent, for never before had a former member of the staff become a trustee, and was also appointed a member of the Royal Commission on National Museums and Galleries, which issued its interim report in 1928 and its final report in two parts in 1929 and 1930, and in 1931 of the newly created Standing Commission on Museums and Galleries. Simultaneously, he was invited by the Carnegie United Kingdom Trust to report on the museums, other than national, in the British Isles, and with the help of S. F. Markham did so in 1928. Almost immediately afterwards, the Carnegie Corporation of New York asked him to make a similar survey of the museums in British territory overseas. With the aid of S. F. Markham, C. Squire, and D. W. Herdman he reported on the museums in Canada and British Africa in 1932; he himself visited both countries. It was an obvious consequence of this work that in 1928 he was elected president of the Museums Association, and once again he proved so successful that he was prevailed upon to continue in office for an unprecedented length of time, and did not vacate it until 1933.

During 1904–9 Miers was president of the Mineralogical Society, and during 1932–37 of the Gemmological Association. In 1941, owing to his defective sight, he was compelled to resign from the trusteeship of the British Museum and membership of the Standing Commission on Museums and Galleries. He was knighted in 1912, elected a fellow of the Royal Society in 1896, and awarded the Wollaston Medal by the Geological Society of London in 1934. Numerous other distinctions, including honorary degrees, were conferred upon him.

G. F. HERBERT SMITH.

Dr. E. J. Allen, C.B.E., F.R.S.

THE Rev. Richard Allen of Lancashire, and his wife Emma Johnson, of Bideford in Devon, had good reason to be proud of their family of eight, which consisted of five sons and three daughters, four of whom survive. The sons were the late Dr. H. N. Allen, professor of electrical engineering and afterwards principal of the College of Science at Poona; the late Mr. C. B. Allen, assistant general manager of the Midland Bank; the late Dr. E. J. Allen, F.R.S., until 1936 director of the Marine Biological Laboratory at Plymouth; Mr. E. L. Allen, of the School of Art, Redditch; and Dr. H. S. Allen, F.R.S., professor of natural philosophy at St. Andrews.

Edgar Johnson Allen, the second son, was born at Preston in 1866, educated at Kingswood School, Bath, and at the Yorkshire College, Leeds. He graduated as an external student of the University of London with honours in chemistry in the Intermediate B.Sc. (1884) and physics in the Final B.Sc. examination (1885). For financial reasons some years were spent in teaching posts, including the headmastership of a school in the West Indies. After his return to Europe, he was engaged in post-graduate study in zoology in the University of Berlin and also at University College, London. In 1900 he graduated as D.Sc. in the University of London and won the Sherbrooke Scholarship. He had already received a research grant from the Royal Society (1893) which enabled him to work at Plymouth.

In 1895 he became director of the Marine Biological Association's Plymouth Laboratory and secretary to the Council, posts which he held for forty-two years, until his retirement in 1936. Under his guidance the Laboratory prospered and became a centre of marine research. It became a centre of physiological research also, for Allen realized the importance of marine animals and plants as subjects for the study of general problems of biology and medicine. Accordingly, it came about that the last scientific paper read by one of his old staff on his way to take up duty as a naval officer was before the Royal Society of Medicine upon the semi-circular canals of the ear, studied through the response of single nerve fibres.

During the earlier years much of the research and the observational work at sea were carried out by Allen himself. But as years went on his duties as director became more arduous and his time was occupied with routine, with advising younger men and attending to the wants of the numerous research workers who came to the Laboratory from distant lands. The impact of the visitors upon the regular staff was, in his view, specially good for the latter, and tended to prevent the departmental miasma of an official laboratory from enveloping them. It was, therefore, a pleasure to him when his attention was directed to Sir Lawrence Bragg's presidential address to the Institute of Physics last July and it was suggested that his moulding of a research institution was upon the lines considered by Bragg to be most desirable.

But though his unremitting and unselfish care for his laboratory left him little time, Allen contrived also to be a good Plymothian and served upon a number of committees. He gave much thought also to the Tees and Mersey Survey Committees of the Department of Scientific and Industrial Research and to the work of the Water Pollution Research Board.

Allen's work brought him general recognition in the learned world. In 1914 he was elected a fellow of the Royal Society. In 1922, at Hull, he was president of the Zoological Section of the British Association. In 1923 the Hansen Memorial Medal and Prize came to him from Denmark. In 1926 he received the Gold Medal of the Linnean Society, followed by the Darwin Medal of the Royal Society in 1936 and the Agassiz Medal for Oceanography of the National Academy of Sciences, Washington. In the previous year he had been made C.B.E. He was also a foreign member of the Royal Academy, Denmark, and an hon. LL.D. of the University of Edinburgh.

Of Allen's forty-three published papers and addresses, twenty-five appeared in the *Journal of the Marine Biological Association*, which he edited for so long. Some of his best early work on the nervous system of the Crustacea appeared in the *Quarterly Journal of Microscopical Science*, and other work on crustacean embryology and histology appeared in the *Proceedings of the Royal Society*; while his work on regeneration and reproduction of the Syllid Procerastea was published in the *Philosophical Transactions*. His work on the culture of planktonic diatoms opened up a trail which has since been actively followed. Of his papers two, on estuarine fauna, were with R. A. Todd. The first diatom paper was with the late E. W. Nelson and in two, dealing with the genetics of Gammarus, he collaborated with Mrs. E. W. Sexton.

E. J. Allen's end came peacefully on December 7 after one day of indisposition, while still full of interests and enjoying a retirement with leisure he had previously lacked. W. R. G. ATKINS.

Lieut. W. Neil Paton, D.S.C., R.N.V.R.

AFTER many valiant aerial combats, which won him the Distinguished Service Cross and a mention in dispatches, William Neil Paton was reported missing off Malta in June last and has now been officially presumed killed. Marine biology has lost a recruit of great promise. Born in September 1914, the second son of Dr. and Mrs. J. Hunter P. Paton of St. Andrews, he was educated at Oundle and Magdalen College, Oxford. After graduating in 1937 he joined the Oxford University Expedition to Grand Cayman and returned in the following summer with a rich zoological collection. He then joined me in experimental work on the vertical migration of the marine plankton being carried out at the Millport Marine Station and was later appointed to the research staff of the Station.

Soon after the outbreak of war, Paton volunteered for service with the R.N.V.R., and received his commission in the spring of 1940. Later he transferred to the Fleet Air Arm and was stationed at Malta. The Admiralty reported the award of the D.S.C. in the following terms: "for outstanding courage and determination in the face of the enemy. This officer carried out sixteen air operations from Malta in all of which he made contact with the enemy and in seven of which enemy shipping was destroyed or damaged. On eight of the operations he was leading the force and was largely responsible for its success". He was mentioned in dispatches for his last action: "the enemy ships, escorted by a strong force of shore-based fighters, were attacking an allied convoy bound for Malta when our aircraft engaged them and pressed home a determined attack in the face of bitter resistance".

Paton threw himself into his scientific work with the same determination; he was a splendid experimenter, never discouraged by failure, always seeking a way to get over difficulties. I am at present preparing his work for publication. He was a man of wide interests and a very human personality, endearing himself to all he came in contact with. To end this brief note I cannot do better than quote a letter from his Oxford tutor: "it is a literal statement of fact to say that life is poorer because one has not sometimes the thought that Neil Paton may be coming around".

Our sincerest sympathy goes to his parents who lost their other son, also in the Fleet Air Arm, in the same way: missing, then presumed killed.

A. C. HARDY.

WE regret to announce the following deaths:

Prof. Rudolf Abel, formerly professor of hygiene in the University of Jena, the eminent German bacteriologist, aged seventy-four.

Prof. F. D. Adams, F.R.S., emeritus Logan professor of geology, dean of the Faculty of Science and vice-principal, McGill University, on December 27, aged eighty-three.

Prof. Franz Boas, emeritus professor of anthropology in Columbia University, on December 21, aged eighty-four.

Dr. Mabel C. Buer, lecturer in economics in the University of Reading, on December 9, aged fifty-one.

Sir Bryce Chudleigh Burt, C.I.E., M.B.E., director of animal feeding stuffs, Ministry of Food, secretary of the Indian Central Cotton Committee during 1921–28, agricultural expert to the Imperial Council of Agricultural Research during 1929–35, on January 2, aged sixty-one.

Prof. W. Caldwell, emeritus professor of philosophy in McGill University, aged seventy-nine.

Prof. F. M. Cornford, F.B.A., emeritus professor of ancient philosophy in the University of Cambridge, on January 3, aged sixty-eight.

Mr. F. W. Harbord, C.B.E., the well-known metallurgist, on December 27, aged eighty-two.

NEWS and VIEWS

New Year Honours List

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

Baron: Sir Charles Wilson, president of the Royal College of Physicians.

Baronet: Mr. W. M. Goodenough, chairman of the Nuffield Trust for the University Medical School, Oxford.

G.B.E.: Sir Henry Dale, lately director of the National Institute for Medical Research, president of the Royal Society.

K.C.B.: Sir Wilson Jameson, chief medical officer, Ministry of Health and Board of Education.

Knights: Prof. J. H. Clapham, president of the British Academy; Prof. F. Clarke, professor of education, University of London; Prof. A. C. G. Egerton, professor of chemical technology, Imperial College of Science and Technology, and joint secretary of the Royal Society; Jhanendra Chandra Ghosh, director of the Indian Institute of Science, Bangalore; Mr. S. H. Howard, inspector-general of forests and president of the Forest Research Institute, Dehra Dun; Pestonji Rustom Masani, lately vice-chancellor of the University of Bombay; Mr. W. A. Stanier, chief mechanical engineer L.M.S. Railway and scientific adviser to the Minister of Production; Brig. E. O. Wheeler, surveyor-general of India; Mr. J. Wright, chief engineer, Central Electricity Board.

C.M.G.: Mr. D. Yates, a leading metallurgist of South Australia.

C.I.E.: Bhagavathulu Viswanath, officiating director, Imperial Agricultural Research Institute, New Delhi; Mr. R. A. MacGregor, chief metallurgist, Department of Supply, Calcutta.

C.B.E.: Dr. W. R. Aykroyd, director of nutritional research, Coonoor; Mr. E. Barnard, director of food investigation, Department of Scientific and Industrial Research; Mr. R. Gushue, chairman of the Fisheries Board, Newfoundland; Mr. E. H. E. Havelock, administrative secretary of the Agricultural Research Council and secretary of the Development Commission.

Prof. G. A. R. Kon

PROF. G. A. R. KON, whose appointment to the chair of chemistry at the Chester Beatty Research Institute, Royal Cancer Hospital (Free), was recently announced, is a graduate of the University of Cambridge; but his career as a chemist has until now been connected with the Imperial College of Science and Technology. Beginning research there in 1914, he was one of the band of workers associated with the late Sir Jocelyn Thorpe in the founding of his school of organic chemistry. Prof. Kon's early work dealt with ring formation and the like, and in the course of it he came across certain ketones exhibiting unusual properties. After the presentation of his D.Sc. thesis in 1922 he followed up these early observations, embarking on a long series of investigations dealing with three-carbon tautomerism, a phenomenon which had not, until then, received systematic attention. One outcome of this work, to which Prof. R. P. Linstead also made substantial contributions, was the elucidation of the chemistry of the glutaconic acids. The contradictory nature of these compounds, which had previously been the subject of controversy between Thorpe's school and that of Feist in Germany, was shown to be due to the simultaneous existence of three-carbon tautomerism and stereoisomerism.

In 1932 Prof. Kon wrote the section on homocyclic compounds in the "Annual Reports on the Progress of Chemistry", and this date marks a complete change in the direction of his work. Having been hitherto concerned solely with aliphatic compounds, he directed his attention to problems connected with the sterols and related substances. He synthesized "Diels's hydrocarbon", $C_{18}H_{16}$, which forms the basis of the sterol skeleton, and helped to evolve the formula of the cardiac aglucones on the basis of the degradative work of Jacobs on strophanthidin. He then turned his attention to the triterpenes. Aided by a number of capable pupils, he largely elucidated the constitution of bassic and quillaic acids. The latter result, in turn, necessitated the revision of the structure of related compounds belonging to the

β-amyrin group, for which a new formulation was proposed. A feature of this work, made possible by collaboration with P. Bilham, was the use of the surface film method for ascertaining the position of the functional groups in these large molecules.

William Hedley : Locomotive Pioneer

ON January 9, 1843, William Hedley, one of the pioneers of the locomotive and iron railway, died at Burnhopeside Hall, near Lanchester, Co. Durham, and was afterwards buried at his birthplace, Newburn on the Tyne. He was then sixty-three years of age, having been born on July 13, 1779. He seems to have had a good education and in his 'twenties became a viewer at the colliery in the village of Wylam, eight miles west of Newcastle-upon-Tyne, where George Stephenson was born in 1781. The colliery was the property of Christopher Blackett, a man with progressive ideas, who in 1804–5 had had a locomotive built at Gateshead to Trevithick's plans. This engine, it appears, was never put into service. In 1811, with Blackett's approval, Hedley made both model and full-size experiments to show that a locomotive with smooth wheels could operate successfully on smooth rails. These experiments led to the construction of some of the earliest locomotives, which were used for the transport of coal from Wylam Colliery to the staithes at Lemington, five miles lower down the river. One of these engines, supposed to have been built in 1813, is the historic *Puffing Billy*, now in the Science Museum, South Kensington. Hedley was as much concerned with the winning of coal as its transport, and during the last twenty years of his life worked or owned various mines in Durham and Northumberland. His own share in the development of the locomotive was clearly stated by him in a letter of December 10, 1836, to Dr. Lardner, who in a lecture at the Literary and Philosophical Society, Newcastle, had spoken of George Stephenson as the "Father of the Locomotive".

Chemical Industry in Europe

IN a recent issue of the *Chemiker Zeitung* an attempt is made to show that chemical industry in Europe is gradually increasing its productive capacity; to such an extent indeed that, after the War, Europe will be entirely independent of Anglo-Saxon domination. Presumably under the beneficent leadership of Germany, together with the organizing and technical skill that this is supposed to include, Europe would no longer need foodstuffs and raw materials from the British Empire : these would be replaced by synthetics, and the reign of *Ersatz* would be almost universal. A survey is made of the chemical industries of the chief European countries, from which Germany, and, of course, the U.S.S.R., are excluded, as also is Turkey. Many of the data, however, are pre-war, or hopeful forecasts of the future. This is more particularly the case with Italy, where some index figures are quoted for the period 1935–39 to show the rapid rise in her chemical output. In France also, practically all that could be said is that a large company has been formed for the production of synthetic fuel from lignite. It is said to be financed by the Banque de Paris, doubtless backed by German financiers or industrialists; but it will be three years before the requisite plant, using the Fischer-Tropsch process, can be installed.

If the intention was to show that European chemical industry, apart from spasmodic attempts to increase output of war munitions, is laying firm foundations for post-war expansion or even taking any appreciable steps in that direction, then the record, on the German writer's own showing, indicates complete failure. As a piece of propaganda it could scarcely deceive even the Germans themselves. Much more space, indeed, is devoted to countries not yet overrun by the Nazis, such as Spain and Sweden, and it is clearly and indubitably shown that only in those countries has any real progress been made in the chemical and allied industries. This is confirmed by non-German and more reliable sources. As a matter of fact, in the German record, many important items are omitted, as if the writer had suddenly realized that he had already said too much and exhibited too painfully the great contrast between German-occupied and unoccupied Europe. Spain's progress in the matter of nitrogenous and other fertilizers is described at some length, and reference made to new factories for the manufacture of tanning materials, sulphur and copper from pyrites, leather, textiles and artificial fibres. Many of Sweden's recent developments in chemical industry are also noted. Compared with these, the few details given about the occupied countries are insignificant trifles, and relate mainly to more or less temporary expedients to replace with indigenous products those which can no longer be obtained from Germany.

The U.S.S.R. in War-time

THE broadsheet "Soviet Planning in War-Time" issued by P E P (Political and Economic Planning) gives a useful objective account of the ways in which the Russian economy has advanced from one mobilized for war in 1941 to a battle economy, and of the general background of this economy. The machinery of Soviet planning functions through three main stages : first, a comprehensive survey of existing resources ; secondly, the formulation of a plan, which is simply the laying down of a series of output programmes which must be carefully dovetailed into each other so that they are consistent ; and, thirdly, a mechanism for checking their progress and for providing the elasticity necessary for periodic adjustments. This machinery was evolved over a considerable period of time, and the broadsheet gives a brief account of the purposes and achievements of the three Five-Year Plans. It was only during the Second Five-Year Plan that the consumption of foodstuffs and living standards generally rose to any appreciable extent, but an important aspect of that period was the development, partly for strategic reasons, of industrial and raw material resources east of the Urals. Both the First and the Second Five-Year Plans between them largely achieved their objectives of the creation of modern large-scale industry and a mechanized agriculture as the basis for raising living standards to a higher level and for national self-sufficiency in war-time.

The Third Five-Year Plan provided for further increases in the output of industry and agriculture, but its most striking feature was the huge increase in the resources devoted to defence. Moreover, the whole organization of Russian economic life, with its machinery for central planning and its high degree of military preparedness, makes for a greater degree of continuity between peace and war economies than in any other country except Germany. Owing to the absence of excess capacity, the war sector from the outset had to be expanded at the expense of the

peace sector of the economy. The producers' goods industries were, so far as possible, adapted to war production and the output of these industries was reduced. Agriculture was seriously affected by labour shortage due to mobilization, which was only in part made up by urban workers and spare-time labour. Excess purchasing power seems to have been skimmed chiefly by increased subscription to State loans. To offset the heavy losses in production resulting from Nazi occupation of European Russia, great efforts, apart from the evacuation of industrial plant and rolling stock, have been made to increase the absolute absorptive capacity of the Ural and Asiatic regions. New sources of raw materials are being exploited, new power stations established, new coal pits sunk and new oil wells drilled. New plantations of rubber-bearing plants, of sugar beet, etc., have been developed, and new substitutes and methods are being employed for the manufacture of sugar and soap. In all this, scientific workers have played a great part, as well as in the simplification and rationalization of many technical processes.

The Solway Tides

A GREAT tidal wave occurred on the Solway estuary on the night of December 9–10, when 3,000 acres between the Rivers Sark and Esk were under water and Sark Toll Bar marriage house was isolated, while 7-ft. fences on Sark Foot farms were submerged. The tide was 25 ft. and was made abnormal and destructive by the wind that came in the wake of a great tidal wave. On the Scottish side the floods reached the highest recorded level since 1900, cattle and sheep were drowned, farmhouses isolated. A 9-ft. embankment was broken in two places along the River Annan and houses were flooded in the Scottish town of Annan. It might have proved more costly but for the fact that because of the mild weather few farmers had brought their sheep down from the mountains to the estuary marshes. The Solway Firth has a history of great tides serious to local farming. Some years ago a tide with less water than that of December 9 killed nearly 1,000 sheep, owing to all the winter flocks being on the marshes. In 1942 the Solway had its usual two high tides of the year, in August and November, and the December one was unexpected.

English Lakeland Fauna

THERE has been a considerable extension of our knowledge of the fauna of the English Lakeland by the activities of the Carlisle Natural History Society. A list of 292 species and sub-species has been drawn up in a manuscript book on "The Birds of Lakeland" to be published after the War, a considerable number of nesting species being added to the Rev. MacPherson's old "Fauna of Lakeland". At a recent meeting of the Society in Carlisle Museum, F. H. Day recorded six new species of Coleoptera added to the Cumberland list in 1942, bringing the total list to 1,849. The new additions are *Triplax aenea*, Schall.; *Gabrius velox*, Shp.; *Aphodius constans*, Duft.; *Liodes glabra*, King.; *Hylastes opacus*, Er.; and *Scolytes intricatus*, Ratz., from an oak log. It was also reported that in 1942 there had been an increase in the range of wall brown and peacock butterflies, also the cinnabar moth in coastal regions, while the rare greasy fritillary butterfly still maintained certain local haunts. A cream-coloured curlew nested at Hosketh Hill and the quail in a clover field at Durdar. The blackcock is still numerous in many haunts. There is a regular pied wagtail roost on the glass roof of Carlisle railway station and another roost in willows by the Caldew. The willow-tit has been recorded in a number of Lakeland localities and a grey shrike was reported from near Brampton at the end of November. Whooper swans remained on a local water until the second week of May.

Earthquakes Registered in Spain

DURING September 1942, thirteen strong earthquakes were registered by the seismographs at the observatory at Toledo. On September 1 there were three shocks, the first beginning with *iPz* at 9h. 47m. 34s. U.T., attaining an amplitude of 13 μ on the N.S. component at 9h. 52m. 01s. U.T. and finishing at 10h. 50m. U.T. The shock apparently came from an epicentre distant 2,980 km., the focus being some 250 km. deep. The other two shocks were much smaller. The earthquake on September 6, which registered at 16h. 06m. 34s. U.T., came from an epicentral distance of 9,470 km. and that on September 9, which registered at 1h. 37m. 59s. U.T., from an epicentral distance of 9,245 km. On September 24 an earthquake which began registering at 3h. 56m. 34s. U.T. attained an amplitude of 11 μ at Toledo at 4h. 42m. 46s. U.T. and finished recording at 5h. 10m. 00s. U.T. It came from an epicentre distant probably 11,710 km. The last earthquake registered in the month was on September 26 at 4h. 12m. 09s. U.T., probably from an epicentral distance of 8,465 km., and finished recording at 4h. 50m. U.T. The readings during the month were to a small extent confused by microseisms, and all readings are tentative.

Comet Whipple

DR. W. H. STEAVENSON observed this comet on December 19, 22 and 29. On the last occasion he described it as large, at least 10′ in diameter, with a well-marked nucleus and a tail about 20′ long. Its magnitude was about 6 on December 29. As Dr. Steavenson is at present absent from his observatory, he was able to give only approximate positions of the comet by using a 3-in. refractor on an altazimuth mounting and estimating the positions from stars in the field. From his data Dr. M. Davidson has computed the following orbit and ephemeris, but they are only approximate owing to the nature of the observations. Those who observe the comet in the early part of the month, for which the ephemeris will probably suffice, should make the necessary corrections for later observations. The comet is approaching the earth and will be about 30 million miles away on January 28. It will almost certainly become a conspicuous naked-eye object during the month.

Orbit

T	1943 Feb. 21·20 U.T.	
ω	57·3°	1943·0
Ω	100·2	1943·0
i	20·4	1943·0
q	1·182	

Ephemeris

Date 1943	R.A. h. m.	Dec.	ρ	r
Jan. 8	9 06·0	+33·3	0·418	1·369
12	9 23·7	37·0	·388	·340
16	9 43·2	41·0	·368	·312
20	10 08·0	45·5	·352	·286
24	10 35·9	49·6	·340	·264
28	11 02·6	53·3	·334	·242

LETTERS TO THE EDITORS

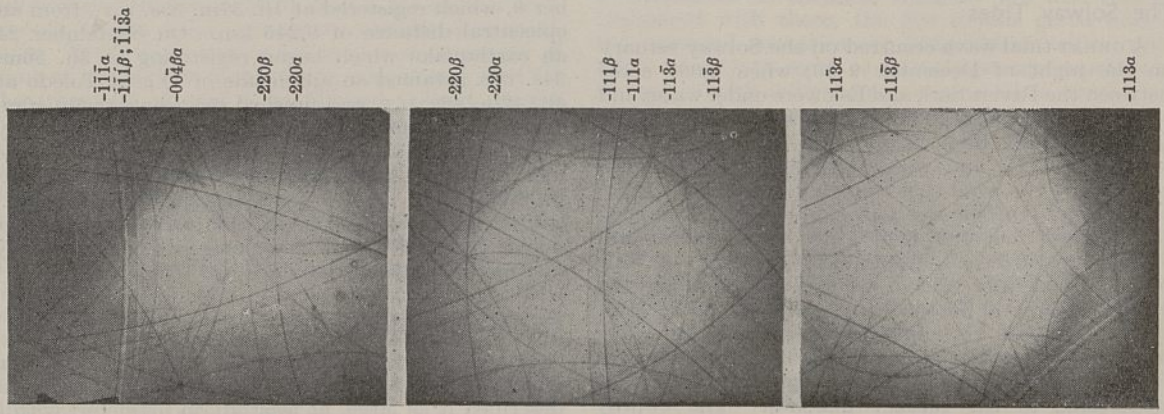
The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Crystal Photography with Divergent X-Rays

KOSSEL[1] has shown that when a single crystal is used as anticathode in an X-ray tube, the divergent characteristic X-rays generated in the crystal are diffracted, according to the Bragg relation, from the various planes in the crystal itself, and a photographic film placed in the neighbourhood of the crystal will show a pattern of black and white lines (conics if the film is plane) on a more or less uniform background. These are somewhat similar to the more familiar Kikuchi lines[2] obtained by electron diffraction methods, but they are much fewer in number and are better resolved. However, Kossel lines can only be recorded when the crystals used contain elements of fairly high atomic number. Fujiwara and Onoyama[3] have obtained similar black and white lines *within the central shadow* by using a convergent primary X-ray beam; and Linnik[4] predicted in 1929 that they would also be obtained by the use of a beam diverging from a pin-hole, but suggested that the inevitable background would spoil the pattern.

This is not necessarily the case. Using a very low input tube designed by Dr. A. Müller, which gives a beam of copper X-radiation divergent externally through an angle of nearly 180°, I have obtained patterns, as shown in the accompanying reproduction, with an exposure of 30 sec. or less, the crystal being a 1·5 mm. thick plate of diamond the octahedral face of which was in direct contact with the point source on the anticathode, the photographic film some 10 cm. away. In general, such patterns can be obtained with copper radiation from any organic crystal or crystal containing atoms of low atomic weight. The lines of the pattern are mostly *deficiency* lines (black in the reproduction but white on the original film) marking those places where the primary intensity has been *reduced* by reflexion, and these cannot show up strongly unless the crystal is thick enough for considerable reflexion to have taken place during transmission. On the other hand, the crystal must not, of course, be so thick as to absorb all the copper radiation. The *reflexion* lines from a thick crystal are weak because so much multiple reflexion takes place within the crystal, and they are in any event few because most reflected rays are directed away from the film, as a simple sketch shows. A thin crystal gives weak deficiency, but stronger reflexion lines. The separation s of the deficiency and reflexion lines, measured in the plane of any incident and reflected ray, is given by $s = \frac{\sin 2\theta}{\sin(\phi+\theta)} \cdot r$, where θ is the Bragg angle, ϕ the inclination of the reflecting plane to the plane of the film, and r the distance from the point source of X-rays to the point of reflexion; s is independent of the film distance. Application of this formula shows that it is the outer layer of the crystal (farthest from the source, but nearest to the film) which is responsible for the reflexion lines found on the film.

Although most reflexion lines are not recorded on the film, deficiency lines corresponding to values of θ very near 90° may often occur in a forward direction.



FILM INCLINED TO OCTAHEDRAL PLANE. Circular line, $22\bar{4}\beta$

FILM PARALLEL TO OCTAHEDRAL PLANE. Circular line to left, $22\bar{4}\beta$; circular line at top, $\bar{1}31\alpha\beta$; circular line at right, $331\alpha\beta$

FILM INCLINED TO OCTAHEDRAL PLANE. Circular line to left, $33\bar{1}\alpha\beta$; circular line to right, $331\alpha\beta$

Light-dark lines from diamond, using copper K divergent radiation.

This is not necessarily the case. Using a very low input tube designed by Dr. A. Müller, which gives a beam of copper X-radiation divergent externally through an angle of nearly 180°, I have obtained patterns, as shown in the accompanying reproduction, with an exposure of 30 sec. or less, the crystal being a 1·5 mm. thick plate of diamond the octahedral face of which was in direct contact with the point source on the anticathode, the photographic film some 10 cm. away. In general, such patterns can be obtained with copper radiation from any organic crystal or crystal containing atoms of low atomic weight. The lines of the pattern are mostly *deficiency* lines (black in the reproduction but white on the original film) marking those places where the primary intensity has been *reduced* by reflexion, and these cannot show up strongly unless the crystal is thick enough for considerable reflexion to have taken place during transmission. On the other hand, the crystal must not, of course, be so thick as to absorb all the copper radiation. The *reflexion* lines from a thick crystal are weak because so much multiple reflexion takes place within the crystal, and they are in any event few because most reflected rays are directed away from the film, as a simple sketch shows. A thin crystal gives weak deficiency, but stronger reflexion lines. The separation s of the deficiency and reflexion lines, measured in the plane of any incident and reflected ray, is given by $s = \frac{\sin 2\theta}{\sin(\phi+\theta)} \cdot r$, where θ is the Bragg angle, ϕ the inclination of the reflecting plane to the plane of the film, and r the distance from the point source of X-rays to the point of reflexion; s is independent of the film distance. Application of this formula shows that it is the outer layer of the crystal (farthest from the source, but nearest to the film) which is responsible for the reflexion lines found on the film.

Although most reflexion lines are not recorded on the film, deficiency lines corresponding to values of θ very near 90° may often occur in a forward direction. This enables very accurate estimates of lattice distances to be made. Moreover, one or two half-minute photographs of a suitably shaped crystal can, in theory at least, supply all the information required to ascertain the unit cell and space-group, since measurements of the co-ordinates of four points on any one deficiency curve will give D, the film-source distance, θ the Bragg angle, and λ, μ, ν (two independent) the direction cosines relative to any arbitrary axes in the crystal, of the reflecting plane. It is not necessary, although it is convenient, for the crystal to have any external faces or to be placed with its crystallographic axes in any particular positions. On account of the short exposures required, this method (which is very simple in practice) might prove to be a useful way of examining non-permanent crystals.

Royal Institution, London, W.1. Dec. 9.

K. LONSDALE.

[1] Kossel, *Gött. Nachr. Math. Naturw. Kl.*, **1**, 229 (1935); *Ann. Phys.*, **25**, 512; **26**, 533 (1936); *Ergeb. exakt. Naturw.*, **16**, 295 (1937); Borrmann, *Ann. Phys.*, **27**, 669; Voges, *ibid.*, 694 (1936); Cauchois and Hulubei, *Comptes rend.*, **206**, 181 (1938); etc.

[2] Kikuchi, *Proc. Imp. Acad. Tokyo*, **4**, 354 (1928); *Jap. J. Phys.*, **5**, 83 (1928); Thomson and Cochrane, "Theory and Practice of Electron Diffraction" (Macmillan, London, 1939), 111 et seq.

[3] Fujiwara and Onoyama, *H ros ma J. Sci.*, **9**, 115 (1939); Onoyama, *ibid.*, 125; Fujiwara, *ibid.*, 233.

[4] Linnik, NATURE, **124**, 946 (1929).

Refractive Index of Coals

THE polarization of the light reflected from coal surfaces has been examined by use of the same apparatus which served for an examination of the intensity of the light reflected at different angles of incidence[1]. As the photocell used had a response spreading from 4500 A. to 10000 A. with a maximum at 7500 A., a water cell was used to absorb the unwanted infra-red radiation. A No. 70 Wratten Monochromat filter was placed in front of the source, and an analysing Nicol prism before the photocell unit.

The reflected intensities of the two components, plane polarized parallel to and perpendicular to the plane of incidence, resolved by the Nicol prism, were measured for various angles of incidence. With increasing angle of incidence, the intensity of the perpendicular component increased whereas the intensity of the parallel component passed through a minimum and then increased. A clearly defined minimum was obtained when the photocell amplification was increased. With visual examination most specimens gave complete extinction at the Brewster angle, but zero readings were never obtained with the more sensitive photo-electric photometer. The angle at minimum intensity was used to calculate the refractive index of the specimen.

No.	Description of sample	Refractive Index: Parallel to bedding plane	Refractive Index: Perpendicular to bedding plane	'Fixed carbon' (dry-ash free) %	Properties of samples
25	Lignite—Xylite ex Prof. Bacon	1·54	—	—	Light brown, woody
31	Lignite—Bohemia	1·64	—	—	Black, banded
13	Cannel—Derby	—	1·57	—	Dull, no macro-structure
8	Durain—Warwick	1·80	1·80	67·8	Dull, visible plant debris
9	Durain—Northumberland	—	1·80	—	,, ,, ,, ,,
21	Vitrain—Leicester	1·67	1·67	61·3	Free burning and coking coals; Isotropic Dielectrics
7	Vitrain—Warwick	1·70	1·70	63·1	
17	Vitrain—Lancs	1·77	1·77	63·8	
23	Vitrain—Kent	1·84	1·84	80·8	Coking coals
22	Vitrain—South Wales	1·81	1·87	74·5	
19	Vitrain—South Wales	1·89	1·90	88·8	Steam coals; Anisotropic Dielectrics
20	Vitrain—South Wales	1·86	1·91	86·2	
5	Vitrain—South Wales	1·80	1·90	95·6	Anthracites
16	Vitrain—County Kilkenny	1·77	1·91	97·1	

Filter No. 70 (λ = 7000 A.) used throughout.

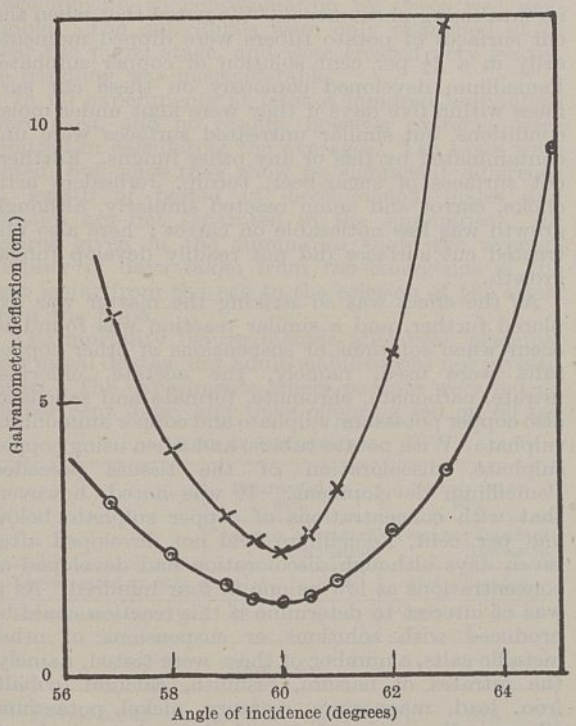


Fig. 1. EFFECT OF POLISHING A COAL SURFACE. $\varphi = 60°$; TAN $\varphi = \mu = 1·73$. CROSSES, POLISHED SURFACE; CIRCLES, NATURAL CLEAVAGE SURFACE.

As this method is less sensitive than those available for transparent substances, special care had to be taken to estimate the position of the minimum. For each determination the galvanometer deflexions were recorded over a region of about 4° each side of the minimum, which was then determined graphically. A typical result is shown in Fig. 1. The lower curve is for a natural cleavage surface, and the upper for the same surface after polishing. This was done with fine emery papers of decreasing coarseness, rotating the specimen through 90° with each change of paper, followed by polishing on 'Selvyt' cloth with moist Goddard's Plate Powder. Although the intensity of reflected light is increased by polishing, the position of the minimum is unaltered. The results were not affected by rotation of the surface in its own plane.

A representative selection of results is shown in the accompanying table giving the refractive indexes, in directions parallel to and perpendicular to the bedding plane of the coals, for λ = 7000 A.

From a large range of results shown in Fig. 2 it would appear that: (i) perpendicular to the bedding plane the refractive index increases with 'rank' or geological age, as shown by the percentage 'fixed carbon' (proximate analysis), to a constant maximum of about 1·9 for anthracitic coals; (ii) parallel to the bedding plane the refractive index first increases

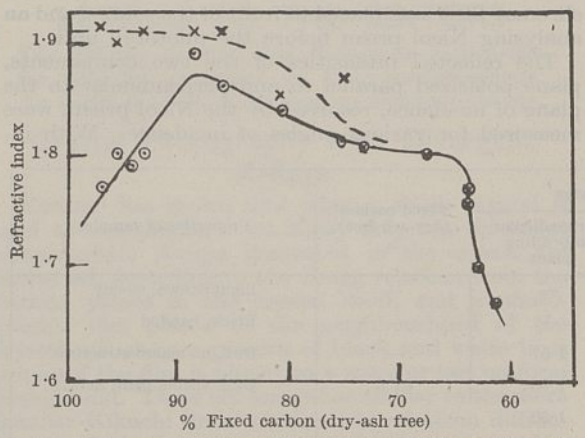


FIG. 2. REFRACTIVE INDEX IN DIRECTION PARALLEL (CIRCLES) AND PERPENDICULAR (CROSSES) TO BEDDING PLANE RESPECTIVELY.

with 'rank' and then decreases for anthracitic coals; (iii) the development of optical anisotropy coincides with the disappearance of coking properties.

For comparison, results for American coals are 1·76–1·87 for bituminous and semi-bituminous coals[2] and between 1·63 for a lignite and 1·80 for a bituminous vitrain[3]. Thanks are due to Dr. D. H. Bangham and Dr. C. A. Seyler for the loan of specimens.

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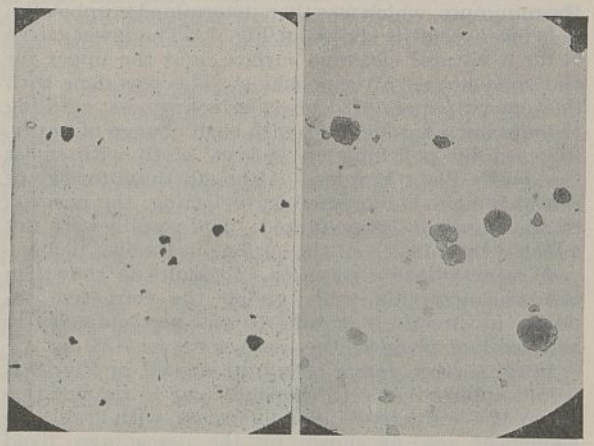
Dec. 17.

[1] Cannon and George, NATURE, **150**, 690 (1942).
[2] Fisher, *Amer. Min.*, **19**, 133 (1934).
[3] McCabe, *Fuel*, **16**, 309 (1937).

Microscope Observations of the Crushing of Coal

So far as I am aware, the peculiar effect described below of a disruptive pressure on small particles of coal has not hitherto been observed. The observations were made in the course of an examination of very fine coal dust from a ball mill which is claimed to grind coal to micron size.



Left hand: ground coal, Swallow Wood seam, dry mounted. Right hand: the same field after crushing the coal. The particles have spread and become translucent. A group of three particles have begun to coalesce to form a single sheet of substance. ×240.

The microscope showed that the sample of dust contained particles up to thirty microns in diameter. A micro-scalpel was pressed on a cover-glass near a selected particle and the effect was watched. As the pressure was increased there came a point at which the particle collapsed into smaller particles which under continued pressure spread and coalesced into a brown patch. Under further pressure the patch spread and became correspondingly lighter in colour and, when about 0·1 micron in thickness, broke into smaller pieces, and then disintegrated into a cloud of fine particles. The accompanying illustrations show the same field of a dry mount of some coal dust of the Swallow Wood seam, a coking coal, before and after it had been crushed on the slide. The particles have all spread and become translucent, and three of them in the centre of the field have begun to coalesce.

The effects of crushing vary considerably according to the type of coal, but in general it seems that coal can behave as a plastic substance. Even anthracites, which hitherto have been obtained only as opaque even in the thinnest section, have become translucent under the simple manipulation described. The observations will be published in more detail elsewhere.

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Development of Penicillium on the Cut Surfaces of Certain Vegetables

WHILE making certain experiments designed to test the efficacy of various fungicides we encountered an interesting phenomenon. We noted that when the cut surfaces of potato tubers were dipped momentarily in a 2½ per cent solution of copper sulphate, Penicillium developed copiously on these cut surfaces within five days if they were kept under moist conditions, but similar untreated surfaces were uncontaminated by this or any other fungus. Further, cut surfaces of sugar-beet, turnip, Jerusalem artichoke, carrot and onion reacted similarly, although growth was less noticeable on carrot; here also untreated cut surfaces did not readily develop fungal growth.

As the effect was so striking the matter was explored further, and a similar reaction was found to occur when solutions or suspensions of other copper salts were used, namely, the acetate, chloride, nitrate, carbonate, chromate, formate and salicilate, also copper potassium sulphate and copper ammonium sulphate. With potato tubers, and when using copper sulphate, discoloration of the tissues preceded Penicillium development. It was noted, however, that with concentrations of copper sulphate below one per cent, Penicillium had not developed after seven days although discoloration had developed at concentrations as low as one in four hundred. As it was of interest to determine if this reaction could be produced with solutions or suspensions of other metallic salts, a number of these were tested, namely, the nitrates of barium, bismuth, calcium, cobalt, iron, lead, magnesium, mercury, nickel, potassium, silver, sodium, strontium and zinc. A marked and early growth of Penicillium occurred only when the cut surfaces were treated with the cobalt salt,

although it developed at a later date and to a much lesser extent with nickel and iron; very slight growth was noted after treatment with mercury.

A detailed account of these observations will be communicated elsewhere.

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R. ERIC TAYLOR.
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Dec. 8.

Effect of Parental Feeding on the Rate of Development and Mortality of *Tribolium destructor* Uyttenboorgaart (Coleoptera, Tenebrionidæ)

THE object of these experiments was to show the effect, on the rate of development and mortality of offspring, of feeding their parents on flour of different extractions. All experiments were carried out under the same conditions (apart from the food used), which were as follows:

Newly emerged first instar larvæ of *Tribolium destructor* (from eggs laid about 200 days after the first oviposition of the female) were put, in fours, in open 3 in. × 1 in. glass tubes; in a dark incubator; at 25° C. (± ½° C.); and at a humidity of 50–60 per cent R.H. (usually about 56 per cent R.H.).

The two kinds of flour used, 85 per cent (National Wheatmeal) and 60 per cent (High Grade White Flour), were kindly provided by the Research Association of British Flour Millers, from a single sample of grain. The food was kept in the incubator, until it had reached equilibrium with the temperature and humidity, before being used; and an ample quantity (about 2 gm. per larva) was provided at the beginning of the experiments, for the full period of development, so contamination by fæces was negligible. The individuals were only examined at or near the pupal stage, and were treated very gently, so handling was inconsiderable.

In all experiments at least a hundred individuals were used, and no results, however extreme, were omitted in calculating the averages. The sexes were noted, but since they show no significant difference in length of period of development, males and females are not separated in the summaries. All figures given in the summaries show the average number of days taken from the emergence of the first instar from the egg to the eclosion of the adult from the pupa.

The mortality figures include all larval, prepupal and pupal deaths, but adult viability was not investigated. The experiments where parents were fed on 85 per cent flour, and their offspring fed on 60 per cent flour, were repeated as a check and it will be seen that the results (average 44·9; standard deviation 2·1; mortality 3 per cent) approximate very closely to those obtained in the original experiment.

RATE OF DEVELOPMENT

	Parents fed on 85%		Parents fed on 60%	
	Average	Standard Deviation	Average	Standard Deviation
Larvæ reared on 60%	44·4	±2·4	52·4	±5·3
Larvæ reared on 85%	43·9	±1·7	48·2	±3·8

MORTALITY

Parents fed on	85%	60%
Larvæ fed on 85%	7%	39%
Larvæ fed on 60%	14%	41%

The results show that the rate of development of the offspring is influenced by the food on which their parents are fed. Thus, whether larvæ are fed on 60 per cent flour or on 85 per cent flour, they develop more rapidly when their parents have been fed on 85 per cent flour than when their parents have been fed on 60 per cent flour. Indeed, so strong is the effect of parental food that larvæ develop more quickly on 60 per cent flour, if their parents have been fed on 85 per cent flour, than they do on 85 per cent flour if their parents have been fed on 60 per cent flour. Applying Fisher's t test to these results, the differences between larvæ fed on the same foods, but whose parents were fed differently, are highly significant ($P<0·01$). The difference between the larvæ which were fed on 60 per cent and 85 per cent (parents 60 per cent) is also significant ($P<0·01$). The difference between the larvæ whose parents were fed on 85 per cent is not significant (P between 0·1 and 0·05).

Similar conclusions are reached from a study of the mortality figures. These again show the advantage to the offspring of parents fed on 85 per cent flour, whether the offspring themselves be fed on 85 per cent or 60 per cent flour. The figures also show that the food of the parent has a greater effect on mortality than has the food of the larvæ.

These experiments are part of some work done voluntarily for the Pest Infestation Laboratory of the Department of Scientific and Industrial Research, and I wish to express my thanks to Mr. G. V. B. Herford and Dr. O. W. Richards for their readiness at all times to give help and advice.

Biology Department, College of Technology, Leicester.
Nov. 19.
J. M. REYNOLDS.

Discoveries by Accident

PROF. RUSS will find it interesting, I think, to refer to the 1929 May Lecture of the Institute of Metals which was delivered by Sir Oliver Lodge on the theme of "States of Mind which Make and Miss Discoveries".

"It is instructive," said Sir Oliver Lodge, "to realise the state of mind which misses a discovery as well as, what is more commonly attended to, the more admirable state of mind which succeeds." Many experimenters had opportunities as good as Röntgen's to observe the X-rays which were generated in their laboratories. Sir Oliver Lodge cited the case of Rev. Frederick Smith who, on finding that the plates wrapped in a box near a tube were fogged, was—so to speak—annoyed at this disturbance of his experiments, and kept the plates out of the way.

I have always remembered the fascinating manner in which Sir Oliver Lodge elaborated the philosophy of the inventive mind in this lecture; and I have remained convinced that the "admirable state of mind" which led Röntgen to follow up his observation fully entitles him to recognition as the *discoverer* of X-rays.

J. C. CHASTON.
Johnson, Matthey and Co., Ltd.,
Research Laboratories,
Exhibition Grounds,
Wembley.

RESEARCH ITEMS

Wooden Implements of a Primitive Tribe

AN interesting light is thrown on the possible methods of early man by a description of modern stone-age man in the Musgrave Ranges of South Australia ("An Unrecorded Method of Manufacturing Wooden Implements by Simple Stone Tools." By C. B. Mountford. *Trans. Roy. Soc. South Australia*, 65, (2); 1941). The Pitjendadjara tribe is one of the most primitive in Australia, and among their few possessions are spear-throwers fitted with an adze stone on the end, and spears. The manufacturing process of the spear-thrower is described by the author. The tools used were natural stones selected for possessing some sort of cutting edge, but undressed. With these as the sole instruments a shaped slab was stripped from a small Mulga tree—a slow and laborious process—and the bark removed before it was taken to the camp. There the shaping and finishing took place with the help of smaller, but still unflaked, stones and finally with the aid of the adze stone of a finished spear-thrower. The adze stones themselves were merely flakes of chert with good cutting edges and were stuck into the handle end of the spear-thrower with spinifex gum warmed over a fire. When these stones became blunted with use there were some attempts to create a fresh cutting edge by tapping them with the wooden blade of a spear until miniature flakes were broken off. The throwing peg was made of wood and attached by spinifex gum to the tip of the spear-thrower and then securely bound with tendon. The stones used in these processes were all discarded and left behind, when finished with; and as such stones bear no recognizable trace of their use by human beings, a material culture such as that of the Pitjendadjara tribe might well become extinct without leaving any trace of its existence.

Pantothenic Acid in Tissue Growth

FOR their growth, many pathogenic organisms require pantothenate, of which there is usually more than enough in animal tissues. On the hypothesis that pantothenic acid takes part in enzyme reactions the progress of which is necessary to growth, H. McIlwain (*Biochem. J.*, 36, 417; 1942) postulates that pantothenate, to be used by an organism, combines with a particular part of it. By analogy with other enzyme inhibitors, it was expected that compounds structurally related to pantothenate might displace it from these enzymes and prevent their functioning. The inhibitions recorded for pantoyltaurine, pantoyltauramide and homopantoyltaurine show that their actions are clearly related to pantothenate and their quantitative interactions were of the character of competitive enzyme inhibitions, probably due to an analogue occupying the active centres to which pantothenate must have access for normal activity. These analogues had less affinity for the enzymes than had pantothenate and needed to be present in many times its concentration to prevent growth. Only organisms needing pantothenate were found susceptible to these compounds. Other analogues were inhibitory to several organisms not needing added pantothenate. Thus, exacting strains of *Cl. diphtheriæ* are inhibited, but not those needing added pantothenate. Such analogues may also act by interfering with pantothenate metabolism, since the latter organisms synthesized the compound.

Fishes of the Genus Bothriolepis

WALTER GROSS, in his work "Die Bothriolepis-Arten der Cellulosa-Mergel Lettlands" (*Kungl. Svenska Vetenskapsakademiens Handlingar*. Tredje Serien. 19, No. 5; 1941), describes in great detail two species of Bothriolepis from the Upper Devonian marls, Kokenhusen, Lettland. One of these, *B. cellulosa* (Pander), is already known; the second, *B. tuberculata*, is new and described here for the first time. Remains of both species occur in the same locality and in considerable quantity, chiefly consisting of the separate bony plates and jointed pectoral fins characteristic of these ancient fishes. The pectoral appendage, which is covered by hexagonal plates, is regarded by recent workers, including the present author, as a true pectoral fin. He suggests the possibility that the fishes here described may be only sexual forms of the same species, *B. cellulosa* being the female and *B. tuberculata* the male. The plates and fins differ in shape and markings and are beautifully preserved. The paper is illustrated by excellent photographs occupying twenty plates.

Sex Ratio in Cattle

IT is sometimes believed by cattle breeders that one sire tends to produce a higher proportion of females than another, and that the sex ratio of the progeny is influenced by the age of the sire. J. W. Gowen (*J. Hered.*, 33, 299–304; 1942) has analysed the data from 3,559 births and reaches the conclusion that neither surmise is correct. Sex determination in families of cattle is at random in most instances, and the age of the sire or dam does not materially affect the sex of its progeny.

Effect of X-rays on *Drosophila pseudo-obscura*

THE haploid chromosome complement of *D. pseudo-obscura* consists of a V-shaped *X*-chromosome, three rod-shaped and one small dot-like chromosomes. Nevertheless, genetical evidence indicates that the arms of the chromosomes are phylogenetically related to those of *D. melanogaster*. P. C. Koller and I. A. R. S. Ahmed (*J. Genetics*, 44, 53–72; 1942) and R. G. Helfer (*Genetics*, 26, 1–22; 1941) show that X-rays produce comparable results in the two species. The frequency of chromosome breaks per detectable changed sperm indicates that the same amount of ionization has similar effects in the two species. A considerable amount of data is given on the distribution and type of chromosome breaks and rearrangements found in X-ray induced and normal material.

Cytology of *Rhoeo discolor* and Tradescantia

P. N. BHADURI (*J. Genetics*, 44, 73–127; 1942) has used the new cytological technique of Semmens and Bhaduri to analyse the nucleoli and secondary constrictions in *Rhoeo discolor* and several species of Tradescantia. As a result he has found that the twelve chromosomes of *R. discolor* which are derived from previous segmental interchanges show morphological differences, that non-homologous segments may be identified in otherwise homologous chromosomes, and that the number of nucleoli are increased by such interchange as well as by polyploidy. *R. discolor*, a structural hybrid diploid, has eight nucleoli in place of the more usual two in non-hybrid material. Similarly, the number of nucleoli and sat-chromosomes is higher in the species of

Tradescantia than would be expected. The size and relationships of the nucleoli are also of importance. Two homologous sat-chromosomes will give similar nucleoli, whereas nucleoli derived from non-homologous parts will probably differ. The author concludes from his analysis of *T. virginana* (4*n*) that it is not an autotetraploid, but is of hybrid origin.

Spectrophotometric Estimation of Vitamin A

J. I. M. JONES and R. T. M. Haines discussed "The Spectrophotometric Estimation of Vitamin A in Fish Liver Oils" at a meeting of the Society of Analysts and Other Analytical Chemists on November 4. The spectrophotometric estimation of vitamin A in low-potency fish liver oils is usually carried out on the extracted unsaponifiable matter, in order to get rid of irrelevant absorption at the characteristic wave-length of 325 mμ. It has previously been stated that no direct relation exists between the absorption so determined and that determined on the whole oil. Re-examination shows that there is a strong correlation between the two values for the same type of oil and that the difference is probably not due to irrelevant matter unless it be that such matter is always present in fixed relation to the vitamin A. Data for cod, shark, halibut and tunny liver oils show this correlation, but the nature of the correlation in cod and halibut is different from that in shark and tunny. There is evidence that the cause of the loss of absorption after saponification is not affected by wide variations in technique, but is related to the nature of the oil and may be connected with adsorption of vitamin by the soap formed during saponification.

Preparation of Deuterium Chloride

ALTHOUGH several methods have been published for the preparation of deuterium chloride DCl, they all have some drawbacks. H. C. Brown and C. Groot (*J. Amer. Chem. Soc.*, 64, 2223 ; 1942) find that by dropping deuterium oxide into excess of heated benzoyl chloride, the temperature being finally raised to the boiling point, deuterium chloride is evolved at a satisfactory rate. The product is analytically pure and the yield practically quantitative. The reaction occurs according to the equations :

$$C_6H_5COCl + D_2O = C_6H_5COOD + DCl,$$
$$C_6H_5COCl + C_6H_5COOD = (C_6H_5CO)_2O + DCl.$$

Hardness of Silver Alloys

THE influence upon hardness of alloying with silver one or more elements which enter into primary substitutional solid solution has been studied by J. H. Frye, jun., and W. Hume-Rothery (*Proc. Roy. Soc.*, A, 181, 1 ; 1942). Accurate Meyer analyses made on annealed bars of vacuum-melted spectroscopically pure silver, assay silver, and on binary alloys of silver containing up to 5 atomic per cent of cadmium, indium, tin, antimony, zinc, aluminium, magnesium and gold show that in contradiction to the statements of some previous investigators, the ultimate Meyer hardness P_u increases as the grain size of the specimens diminishes. Reduction of the results to P_u values for one standard grain size enabled an accurate comparison to be made of the relative hardening effects of the different solutes. When these results are considered from the point of view of lattice distortion, it is shown that for a given atomic percentage of solute, the increase in P_u is proportional to the square of the lattice distortion for solutes in the same row of the Periodic Table. No simple relation was found for solutes from different rows of the Periodic Table, and for a given solute the relation between P_u and the composition is not necessarily simple. The conclusions are tested by experiments on ternary alloys, and data for copper alloys are discussed.

Diameters of Extragalactic Nebulæ

IN an important note (*Proc. Nat. Acad. Sci.*, 28, 186 ; 1942), Dr. H. Shapley gives the results of a photometric comparison of spheroidal and spiral galaxies. It appears that, contrary to earlier indications, the open spirals with their widely extended arms are not appreciably larger than the structureless spheroidal forms. The new measurements, unlike the previous estimates, are based on precise microdensitometer readings taken on properly standardized plates, and reveal little difference in linear diameter between the various types of extragalactic nebulæ. The early suggestion that spiral arms are expelled dynamically from the nucleus during evolutionary development would thus seem to be premature : such features are to be regarded rather as due to a change of structure well within the main body of the system. If, as may well be, the direction of evolution is from spiral to spheroidal, then the condensed arms, supergiant stars and diffuse nebulosities of a spiral system must eventually merge into the featureless smooth form of the typical spheroidal galaxy by a process of internal readjustment and not by contraction.

Transit of Mercury on Nov. 11-12, 1940

VISUAL observations of this transit collected from Australia, New Zealand, Japan, the Philippines, and North and South America have been reduced and discussed by G. M. Clemence and G. C. Whittaker (*Pub. U.S. Naval Obs.*, 15, Part II, 1942). Altogether two hundred observations are combined in various ways to obtain the universal time of geocentric contacts II and III. The residuals from the indiscriminate mean are not distributed according to the normal error law, large values occurring too frequently, and the effect of excluding certain of the observations with large residuals is examined. Probable errors of ± 1·0 sec. and ± 1·2 sec. are assigned to the times of contacts II and III respectively. The adopted observed times *O* are then compared with the theoretical values *C* obtained after correcting the Tables of the Sun and Mercury for small errors of the elements. The so-called "fluctuations" $O-C$ which result are caused by irregularities in the rotation of the earth, leading to errors in the reckoning of astronomical time. The fluctuation at contact II is 43·1 sec., while the value at contact III is 25·5 sec., the weighted mean of 36·1 sec. agreeing well with the 35·3 sec. obtained for the time of transit from lunar observations. The discordance between the two contacts indicates that the duration of the transit was 18 sec. less than the expected value, and consideration of the interval between contacts III and IV confirms this discordance. It may be attributed partially to physiological and psychological factors attending a difficult observation of this kind, but no completely satisfactory explanation can be given at present. The observations taken as a whole provide a welcome independent check on the results obtained by observations of the moon.

SCIENCE AND THE UNITED NATIONS

THE Conference on "Scientists of the United Nations and the War Effort" convened by the Association of Scientific Workers on December 5–6 covered a very wide field. Men of science must leave no doubt about their attitude to the ideologies and practices of the Nazis and Fascists. There is no question about the importance attached to science by the Nazis. Dr. Kuczynski, the famous statistician, speaking of Germany, told of the prestige there enjoyed by men of science. Speakers from Norway, Belgium and Denmark spoke of the attempts of the Nazis to impose their ideology through the universities and schools. These speakers and a Greek man of science, whose name was not published, also told of the resistance which the staffs of universities and schools are making. In Norway, for example, the universities have refused to do anything that was not legal before the invasion; the school teachers have resisted Nazi orders although one in five has been sent to a concentration camp.

The Norwegians had to face a clear-cut issue and made their choice; in Germany, as Dr. Kuczynski related, many men of science were not deliberate supporters of the Nazi regime; but, because they hoped to continue their work without interfering in public affairs, they have become active assistants of the Nazis. This leads to a point made by Dr. G. Lewi, formerly secretary-general of the Federation of Czechoslovak Chemical Industries, deputy chairman of the Association of Czechoslovak Scientists and Technicians in Great Britain, who said that men of science, on whose work the whole structure of modern civilization is built, may not remain aloof from running that civilization. If they do, they will compromise with evil and find themselves committed to the wrong side.

The part played by the people of the occupied countries in the development of science was stressed by many of the speakers. Austria, as Dr. Stock pointed out, has produced six winners of Nobel prizes for science—one per million of population; the three living prize-winners left the country after the Anschluss. Mr. Pevtich, press attaché of the Yugoslav Embassy, told of the numerous Yugoslavs who have made conspicuous contributions to science. Dr. Frankenstein, professor of international law at The Hague, spoke of the debt which German science owes to Jews, of the valuable contributions to the Allied cause by Jews in Palestine in making instruments of precision and of the chemical work of Dr. Weissman, the Zionist leader. During the civil war in Spain the encouragement given to science by the Republicans had borne fruit in the development of an extensive blood transfusion service, the first of its kind, and a new method of treating wounds. In China the growth of science has been checked by the Japanese invasion, but continues and has been concentrated mainly on problems, such as those of nutrition and agriculture, that will be involved in reconstruction.

In the selection of a person for any position, two criteria only should be considered: he should be whole-heartedly opposed to Nazism and Fascism, and he should be the best qualified to do the work involved. In a time of total war we cannot take irrelevant matters such as nationality into account. Prof. Cassin, legal advisor to General de Gaulle, was able to claim that all men of science among the Fighting French, both in Great Britain and the United States, are able to play their part to the full in the common struggle. Miss Simpson, secretary of the Society for the Protection of Science and Learning, told of the work that the Society has done, first in finding positions for refugees and later in securing the release of men of science who were interned in Great Britain; only twelve out of 526 appeals for release have been refused. Mr. T. H. Brind, of the International Labour Branch of the Ministry of Labour and National Service, spoke of the efforts made by his branch to overcome the difficulties that arise in getting full employment for alien scientific workers. However, several speakers expressed the view that adjustment is not complete. Even if no obstacles are raised by any Government Department there remains the prejudice of individual employers, which is likely to persist so long as the most ardent opponents of Nazism are labelled "enemy aliens". If the services of distinguished men of science are not used, agitation can be made and the matter is put right. But there is no machinery for redress in such a case as that of a young man who had served with the Pioneers in France, had distinguished himself in a course of training in making instruments of precision, but was then not employed on the work to which he had been trained; for fear of military discipline, he cannot let his name be used. Also, until the men of science who supported the Spanish Republic and are now in North Africa are freed, we are not using all the scientific personnel at our disposal.

Prof. S. Chapman discussed the use of scientific personnel in the War. He suggested that there is a danger of overlapping of work and that this might be avoided if a central directory be set up from which a responsible person could learn whether any question which he proposed to study was already under investigation.

At the end of the Conference the following resolution was passed:

"We, scientific workers from countries menaced or oppressed by Nazi-Germany and her Allies, assembled in London in a conference, have resolved on the following.

"We accuse Germany and her Allies of systematically destroying the scientific institutions and exterminating the scientists of the occupied countries, as an integral part of her warfare, with the intention of strangling the scientific life and culture of those countries.

"We pledge ourselves to give our best in the fight against such monstrous barbarism, and to answer to-day each new crime with a further intensification of our efforts on behalf of the suffering peoples of the world by striking harder against these enemies of mankind.

"We appeal to our colleagues on the Continent and throughout the world to increase their efforts of which we hear again and again with emotion and pride against the oppressors. Only deeds count to-day and this applies equally to the freedom loving scientists on the Continent and to ourselves.

"We warn those who to-day willingly work for our oppressors that retribution is near.

"We express our satisfaction that a very considerable number of foreign scientific workers have already found work in this country which enables them to use all their knowledge and training in the common war effort, and hope that soon all of us will have found a place where the best use can be made of our experience and willingness to serve.

"We shall work to ensure that the co-operation among the scientists of so many countries which is developing to-day shall be a model for the integration of the world scientific effort after victory has been won."

NEWTONIANISM AND SCHOLASTICISM

IN his presidential address to the annual statutory meeting of the Royal Society of Edinburgh, under the title "Aristotle, Newton, Einstein", Prof. E. T. Whittaker compared the modern revolution in physics, by which the ideas of relativity and the quantum theory have displaced those of Newtonian mechanics, with the revolution in the seventeenth century when Newtonian mechanics triumphed at the expense of Aristotelian Scholasticism. His main thesis was that the Scholastic ideas which were destroyed by the movement of which the work of Newton marked the culmination, were a perverted form of the true philosophy of Aristotle, and that the modern outlook represents a return—or at least a tendency to return—to the true Aristotelian outlook. The work of Tycho and Kepler disproved and overthrew the existing Scholastic cosmology, but it contained nothing inherently irreconcilable with the Scholastic metaphysics and might conceivably have been absorbed into the philosophy of the Schoolmen by a peaceful and conservative revolution. Actually, however, what was essentially a new metaphysic was introduced. The basic postulate of the Newtonian mechanics, in which it differed sharply from Scholasticism, was the fundamental and independent status accorded to space and time. Persistence of bodies in time and their displacement in space became the concepts to which everything in the external world had to be reduced, and bodies moved in obedience to the forces which acted on them in space and time.

A partial return to the Aristotelian view that all change is a transition between a state which is potential and a state which is actual came with the doctrine of the conservation of energy, in which force is ignored and a change is represented by a transition between potential and other forms of energy; and this tendency has more recently been emphasized by the quantum mechanics, in which the operator corresponding to classical potential energy is closely akin to the Aristotelian concept of potency. The introduction of 'minimum' principles, which culminated in 1915 when Hilbert introduced a 'world function' which determines all physical events in the universe by the condition that its integral taken over the whole of space-time is a minimum, marked another drift back to Aristotelianism, since such principles, like Aristotle's, are essentially teleological. General relativity, according to which gravitation represents a continual effort of the universe to straighten itself out, is so completely teleological that it would certainly have delighted the hearts of the Schoolmen. A free particle, in relativity theory, moves in a path determined solely by the curvature-properties of space; it is, as the Aristotelians would say, *in potency* with regard to space.

The importance of quantum theory from this point of view is that it shows that there are events in the physical world which cannot be represented on the background of space and time. Space and time must accordingly be deposed from the dominant position which they held in Newtonianism. We must begin not with space and time but with events; and the atom, which has a potency of various states, is correlated to the states as potency is to act. It endures as the atom, while it takes different states in succession. Thus, the proton and neutron are now regarded as two 'states' of a single entity, often called a 'heavy particle'. In Aristotelian terms, the heavy particle would be 'matter' and its determinations as a neutron or proton would be its two possible 'forms'. Matter is correlated to form as potency to act.

The peculiarities of modern statistical theory also are conveniently expressible in Aristotelian language. An electron can freely interchange its recognizability with other electrons; it has no sameness of being, no proper identity, no separate history. Its selfhood is merged in an electronhood which it shares with all other electrons, and which is correlated with it as potency to act. This reopens the question which engaged so much attention in the Middle Ages, regarding the nature of *universals*, or general terms, which represent the common basis of a class of individual objects.

Prof. Whittaker considers that these tendencies of modern physics should lead to more intercourse and mutual understanding between men of science and philosophers; for of all types of philosophy, the Aristotelian-Scholastic is, in its principles, the most congenial to the scientific mind. It is in a sense true that correct, even if in some respects limited, knowledge regarding physics can be combined with any view whatever on the fundamental questions of being and reality, but the effect of such segregated thinking has been to make science a departmental affair, having no influence on life and thought except indirectly through its applications. At the present time there is a movement in scientific circles aiming at securing for science a greater influence on human affairs, and even calling for a refounding of civilization on a scientific basis; but its advocates do not always understand that, as a necessary condition for the possibility of such a reform, science must be reintegrated into a unity with philosophy and religion.

ESKIMO CRANIOLOGY

THE first part of a catalogue of human crania in the United States National Museum was issued in 1924. It gave measurements of four short series from parts of Alaska. Since then the Smithsonian Institution has sent eighteen anthropological expeditions to the country, and the United States National Museum now has 2,200 Eskimo skulls, many of which are accompanied by the rest of the skeleton. The latest part of the catalogue to be issued* provides individual measurements of the whole collection of skulls, including a number for which data had been published previously. Dr. Hrdlička, the doyen of American physical anthropologists, has thus made another substantial contribution to the long list of his achievements in collecting, describing and analysing the material of his science.

For each specimen nineteen absolute measurements and twelve measurements of shape (indices and angles)

* *Proc. U.S. Nat. Mus.*, **91**, 169–429 (1942). "Catalog of Human Crania in the United States National Museum Collections: Eskimo in General", by Aleš Hrdlička. (Washington, D.C.: Gov. Printing Office.)

are given. The set of characters which should be recorded in craniometric studies has not been standardized, and a fuller list has frequently been used. The aim in all cases has been to give a general description in metrical terms of the skull as a whole and of all its principal parts, such as the brain-box, orbits, nasal aperture and so on. Owing to the lack of international agreement, the same character has sometimes been measured by different observers in two or more ways, thus making the data less useful than they might have been with the same expenditure of labour. In spite of these drawbacks there is extensive comparative material for nearly all the measurements given in the Eskimo catalogue.

Scientific workers other than anthropologists are unlikely to have any just appreciation of the scope and uses of such records. There has been no convenient digest of them, and the problems of racial history which they should elucidate apparently remain obscure. All countries in the world are represented by well-described series of skulls, and those long enough to give a reasonably good representation of a population—series comprising fifty or more fairly complete specimens of one sex, say—range from about 5000 B.C. to modern times. The peoples that have been best described in this way are the ancient Egyptian (about 5,000 specimens), Eskimo (Hrdlička, and Fürst and Hansen, 3,000), British (3,000) and Norwegian (Schreiner, 2,500). The number of Eskimos is now considerably greater than that for all other American peoples put together, if artificially deformed skulls are left out of account. It is fortunate for anthropologists that the arctic population did not adopt the unnatural practice which was common in most other parts of the continent.

Study of differences between the physical characters of Eskimo communities may be expected to throw light on the problem of the peopling of America. Dr. Hrdlička has discussed this matter at length elsewhere and he refers to it briefly in the notes appended to his new catalogue. Considered as a whole, the Eskimo population has long been recognized to be of a specialized type, as are the isolated human populations found in other remote parts of the world. The typical skull is characterized by a median ridge on the vault, and the great breadth and large size of the facial skeleton are other striking peculiarities. In spite of the basic similarity of the type throughout the population, average measurements given for local groups reveal clear differences in some characters. The cephalic index in particular makes many distinctions which are markedly significant. In general it is higher in the west and lower in Greenland, though the lowest value is for an Alaskan series which is also distinguished by being the oldest. It is assumed that the group must have spread in relatively recent times on account of linguistic and cultural similarities over all its present region. The inference is that the mixture or changes which led to physical diversity "took place not on the American continent but well back in the original habitat of the people, which doubtless was Arctic Asia". Although the evidence is fairly extensive already, it is necessary to ask for more—relating particularly to older Eskimo and related peoples—before skeletal material can be expected to reveal clearly the racial history of Eskimos in America. In considering such questions the need for fuller knowledge is constantly felt.

The cranial measurements given in the catalogue are not analysed statistically there, but they might be used to illustrate the essential nature of all modern populations of *Homo sapiens*. Variation within any subgroup is found to be very considerable, the range for any metrical character being not less than half the range for the total species. The more isolated populations, such as the Eskimo, are found to be only slightly less variable than those of Europe. Gradations within the culturally defined group, and also between it and neighbouring groups, are always observed. Anthropological data supply innumerable examples of character-gradients (or 'clines' as Huxley has recently named them), and it is owing chiefly to their existence that no agreement has yet been reached regarding the way in which races of modern man can best be defined.

Geneticists have hitherto taken little interest in polygenic characters such as cranial measurements, and it has not been shown that any skeletal characters which anthropologists might use for their special purpose are other than polygenic. A few characters of living people controlled by small numbers of genes are known, but there can be little hope of disclosing any details of the course of racial history by treating them alone. Evidence of a palæontological kind seems to be essential for that purpose. It may be anticipated that data such as those placed on record by Dr. Hrdlička will be used by future generations of anthropologists, even if they treat them by methods as yet unimagined. G. M. MORANT.

FORTHCOMING EVENTS

Saturday, January 9

ASSOCIATION OF SCIENTIFIC WORKERS (in the Lecture Theatre of the London School of Hygiene, Keppel Street, London, W.C.1), at 2.15 p.m.—Conference on Problems connected with the Organisation, Application and Personnel of the Medical Sciences. (Chairman: Dr. D. McClean.)

Monday, January 11

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Discussion on Flying Maps.

Tuesday, January 12

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, Westminster, London, S.W.1), at 2 p.m.—Sir Charles G. Darwin, F.R.S.: "The Extreme Properties of Matter" (James Forrest Lecture).

SOCIETY OF CHEMICAL INDUSTRY (CHEMICAL ENGINEERING GROUP) (JOINT MEETING WITH THE INSTITUTION OF CHEMICAL ENGINEERS) (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. H. Ter Meulen: "The Solvent Extraction of Lubricating Oils".

ILLUMINATING ENGINEERING SOCIETY (at the E.L.M.A. Lighting Service Bureau, 2 Savoy Hill, Strand, London, W.C.2), at 5 p.m.—Mr. H. C. Weston: "Proposals for a New Lighting Code".

Wednesday, January 13

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. Anthony Hurd: "Agriculture To-day and To-morrow", 3: "Research and the Farmer".

Thursday, January 14

PHARMACEUTICAL SOCIETY (at 17 Bloomsbury Square, London, W.C.1), at 7 p.m.—Mr. F. H. Cotton: "Synthetic Rubbers".

Friday, January 15

ROYAL SOCIETY OF ARTS (JOINT MEETING OF THE INDIA AND BURMA SECTION WITH THE EAST INDIA ASSOCIATION) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. Maurice Yeatts: "The Indian Census of 1941".

APPOINTMENTS VACANT

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

LECTURER IN MECHANICAL ENGINEERING in the Oxford Schools of Technology, Art and Commerce—The Chief Education Officer, City Education Office, 77 George Street, Oxford (January 17).

DIRECTOR of the National Froebel Foundation—The Secretary, National Froebel Foundation, 2 Manchester Square, London, W.1 (February 27).

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

SPEECH THERAPIST—The Education Officer, County Hall, Wakefield.

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