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CONTENTS

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COUNCIL FOR BRITISH ARCHÆOLOGY

THE inter-war period 1919–39, now so generally criticized for failures in the political and economic arenas, may be found in retrospect to be a Golden Age in the development of the science of field archæology in Britain, comparable with the period of rapid advance in the science of geology in the first half of the nineteenth century. Pitt-Rivers laid its secure foundations in the late nineteenth century, and in the years since his death there has never been lacking one or more men imbued with his ideas, and utilizing his technique ; but whereas such competent workers were, up to 1919, in a minority, their practice was thereafter standardized and developed in respect of both excavation methods and record. Improved mechanical devices such as air photography and the Rolleiflex camera, and ease of access to remote places brought about by the motor-car and road improvement, were also contributory causes.

The results of improved transport facilities in particular are reflected in the published work of the period. The motor-car enabled middle-aged archæologists to be on a site distant from habitation during the whole period of the working day without physical exhaustion ; a 'travelling' earthwork such as Offa's Dyke could be subjected without difficulty to the scrutiny of one individual throughout its length ; and widely distributed examples of any specific type of ancient structure could readily be studied by one person in the course of a single summer holiday. Hence field survey, in advance of or correlated with excavation, has flourished exceedingly. Collaboration with students of the natural sciences, brilliantly illustrated, for example, in the palæobotanical field (pollen analysis), has aided the rapid advance in knowledge of Britain's unwritten history.

Under the leadership of the Society of Antiquaries of London, the Society of Antiquaries of Scotland, and the Congress of Archæological Societies (founded in 1888) programmes of research were, during the years under consideration, co-ordinated, and sites for excavation selected for their probable contribution to the solution of outstanding problems of a period or locality, though local initiative was never supplanted. The same period saw the remarkable growth in scope and range of the Ancient Monuments Branch of H.M. Office of Works, charged under the Ancient Monuments Acts of 1913 and 1931 with the guardianship and preservation of monuments in State ownership, and with the protection of specific sites (scheduled monuments) deemed of national importance, though in private ownership. During the period when Sir Charles Peers was chief inspector of ancient monuments, the governing principles and standards of preservation work were established ; and these compare favourably with anything achieved elsewhere, though the safeguards against damage and destruction of scheduled monuments did not prove altogether satisfactory. The appointment of an archæology officer to the Ordnance Survey in 1921 led *inter alia* to the production of a remarkable series

of period distribution maps on a national basis; for example, long barrows and megaliths, Roman Britain, the Dark Ages. These illustrated the laws governing human settlement in early times—the relation of man to his environment—as expounded by O. G. S. Crawford and others, and now generally accepted by archæologists and geographers alike. Perhaps the main weakness during these years was a lack of understanding of the significance of these widespread activities, even on the part of the educated public, among whom the concept of archæology as a 'treasure hunt' still lingered.

The War has in part interrupted and in part modified this progress; field work has been undertaken of necessity, not of choice. Service and other departments have taken over large tracts of land, many of which included sites and structures of archæological interest, and these it was clear could not be preserved. Thus a unique opportunity was presented of excavating under State auspices, and at State expense, ancient sites thus accidentally involved. When the full story can be told, it will be realized that a great gain in knowledge and technical experience among field workers stands to the credit of the Ancient Monuments Branch of the Ministry of Works, which has organized this process of salvage, as well as to the Service departments for their enlightened and fruitful collaboration.

Conscious of the problems of the post-war years, archæologists have been stocktaking; a lively conference, held under the auspices of the Institute of Archæology of the University of London in August of last year, discussed "The Future of Archæology" at home (and abroad)*; divergence of views on the desirability of State help and control was noticeable, unanimity of view on the importance of education—the technical training of archæologists themselves and the diffusion of knowledge among teachers of the archæological approach to the past. One fact was at the back of all thoughts and all discussion of the future of archæology in Britain. As a result of bombardment, English cities of known antiquity have had great areas laid waste, London, Southampton, Exeter, Canterbury being outstanding examples, and plans for reconstruction may involve further demolitions. Thus the post-war period, as is now well recognized, offers a great opportunity, by the intensive study, prior to rebuilding, of the remains of ancient structures and stratified deposits in such areas, of recovering much of the history of our most important urban centres. This opportunity can never recur, for modern methods of construction of commercial buildings involve deep disturbance and removal of the relic-bearing accumulation of soil.

Hitherto there has been no central organization with a claim to speak authoritatively for British archæology as a whole, ranging from the study of Palæolithic man to that of his Victorian descendants, and the necessity for such an organization was now generally felt. On the initiative of the Roman Society, consultations were held during 1942–43 at the invitation of the Society of Antiquaries of London, under the chairmanship of the president, Mr. (now Sir) Alfred Clapham, and resulted in the formation of a Council for British Archæology, which held its first meeting in March, 1944. As at present constituted, it consists of upwards of a hundred members, representing national archæological societies, county and local societies regionally grouped, unive sities and colleges in which archæology is taught, national museums, the regional museums' federations, and certain societies with kindred interests: the Council has appointed an executive committee, organized its members into regional groups, and set up consultant panels of experts for periods from the Palæolithic to the Renaissance. It is also inviting the collaboration in an advisory capacity of persons eminent in the natural sciences. As a tribute to the status of the Society of Antiquaries of London and the particular services it gave in connexion with the formation of the Council, the first president, who will hold office for three years, will be the president of the Society, Sir Cyril Fox; the honorary secretary is Miss K. M. Kenyon, of the Institute of Archæology, Inner Circle, Regent's Park, London, N.W.1.

The Council is not intended to be an executive body; it will not undertake excavation. Its purpose is to ensure that archæological interests are not neglected in the future and to assist groups or individuals working to that end. It will, for example, urge the strengthening of existing measures for the care and preservation of historic buildings and antiquities, present a case for State aid in excavation as and when the magnitude of the task appears to be beyond the resources of existing societies' funds, and will co-operate, in its own field of interest, with the Museums' Association. It is pledged to work for the adequate recognition of archæology in the educational system of Great Britain and to further measures designed to enlighten the public concerning the records and monuments of the past. It will co-ordinate and facilitate the provision of expert advice on archæological matters. Its most urgent task will be to press upon the authorities concerned with reconstruction the importance of safeguarding archæological remains on sites affected by rebuilding or development; or if preservation is impracticable, of ensuring that scientific examination and record are made before destruction.

The first-fruits of the Council's work are already in evidence. An independent committee for Roman London has been formed, a deputation from which has been received by the Lord Mayor, to consider the many and various problems of the remains of *Londinium*, the great commercial and administrative centre that was the City's precursor, which lie some 20 ft. below present-day street-levels. But effective official and corporate action in these important matters, as in others with which the Council is concerned, depends ultimately on the sanction of public opinion, and the urgent need of educating the public is fully recognized.

Unenlightened persons may have argued that archæology has no practical value and that after the War all efforts should be devoted only to 'things that matter'. But archæology, especially of the earlier

* Occasional Papers, No. 5: University of London, Institute of Archaeology. Pp. 100. See also *Nature*, 152, 320 (1943).

periods, will surely be of real and practical value in the post-war world from two points of view. In the first place, it is an almost ideal hobby study, and a democracy which is ever reaching towards more pay and shorter hours of work must be careful to further intellectual leisure occupations. Field work in archæology can be undertaken during holiday periods and useful evidence exposed by many ordinary folk who take the trouble to undergo a not too arduous course of training. Thus can archæology contribute to that cultural training which is so essential alongside other social disciplines as distinct from the more direct vocational studies.

But more important still is the fact that in the study of archæology, particularly of prehistory, science and humanity meet: the subject is man, yet the methods of work and the discipline are strictly scientific. As a training for the young it is therefore ideal—the human interest is always there, and their minds are broadened by the problems and other subjects they are brought up against during their work, while the whole approach to the subject and to others, like geology, which are involved is scientific. It has indeed been urged that archæology should be included in the curricula of secondary, and even of senior, schools. This would involve the training of a number of teachers, but it is a goal well worth aiming at. One way to start the ball rolling would seem to be to urge on the commissioners in charge of the Civil Service schedules for entrance examinations the wisdom of including archæology among the optional subjects. Many of these are now included to test the mental capacity of the candidate rather than for their practical usefulness in the service he is entering, and archæologists can indeed claim that their subject is ideal from this point of view.

Once recognized by the Civil Service as an examination subject, those who regulate the schedules for the higher certificate examinations of schools, and even for the humbler school certificates, would quickly turn their attention to the problem of including it in their programmes too. Here would be a splendid opportunity for the new Council to help by urging the Government to give the lead. The fact that several eminent Civil servants are on the Council will ensure that its requests to authority are practical.

So also might the universities, in their post-war replanning of courses, consider archæology as a subject of study for those students in the faculties of science and arts and in the training departments who are not making the subject their principal study; for thus can archæology help to widen the scope of university studies.

In this and in the other ways already outlined it will be excellent if the newly formed Council will tackle the problem of educating the nation to the importance of the subject of archæology and of gaining official recognition thereof. This, together with its concern for the safeguarding of ancient sites and the co-ordination of archæological effort, will cause every archæologist, inarticulate spade-worker and ready-penned publicist alike, to welcome its formation as filling a need of which they have long been conscious.

DYNAMICS OF SOCIAL SECURITY

The Price of Social Security

By Gertrude Williams. (International Library of Sociology and Social Reconstruction.) Pp. vii+199. (London: Kegan Paul, Trench, Trubner and Co., Ltd., 1944.) 12*s*. 6*d*. net.

MRS. GERTRUDE WILLIAMS' book is as topical as its title suggests, but on other counts than would appear on the surface. It is in reference to the White Paper on Employment Policy that its significance chiefly lies; but it closes with a sound and constructive criticism of the Civil Service which is equally pertinent to discussion of the Assheton Report on the Training of Civil Servants. Fundamentally, the book is a study of the mobility of labour and, cogently as Mrs. Williams argues that a new mobility of labour must be part of the price to be paid for social security, it may well be doubted whether the emphasis placed by Sir William Beveridge on labour mobility, and on the selection and training of staff for the Ministry of Social Security with special regard to the functions of serving the public and understanding the human problems with which they will be concerned, is likely to reconcile those who purchase the book on the ground of their interest in social security or to find an answer to the question: Can we afford social security?

It would be unfortunate if such disappointment prejudiced the success of such an excellent exposition. Mrs. Williams is an able chronicler, and her descriptive writing is clear and not obscured with unnecessary detail. She has the knack of bringing out the main points and avoiding irrelevancies, and even the disappointed enthusiast for the Beveridge Plan should be grateful for the indications given of fundamental changes in our industrial structure which have a profound bearing on the practicability of that full employment policy which is postulated as Assumption C in the Beveridge Plan.

If the title is misleading, it is not irrelevant. Mrs. Williams is not concerned with the financial aspects of social security but with the economic, social and industrial consequences. She emphasizes the danger that improved social services may harden the arteries of the economic system. We have given up one set of incentives without even facing the fact that we need something to take their place, and her discussion of the psychological problems of adapting incentives to work to a changing world, and of how far a sense of social obligation can supersede hunger as a spur to effort, leads to the conclusion that we must pay the price of social security by instituting in peacetime as in war some degree of State control over occupational distribution.

The first three chapters of the book, in which Mrs. Williams analyses the factors which impede the mobility of labour, should be widely read as an exposition of the argument condensed into the sections on distribution of labour and mobility of labour in the White Paper on Employment Policy. The Government could desire no better justification for its arguments than this able study of the reasons why labour should be fully and continuously mobile if we are to take advantage of the opportunities given us by improved techniques and new knowledge, and why, on balance, mobility has decreased in spite of some factors tending towards its increase. The provision of maintenance during employment has reduced the urgency of the need for finding new

employment and thereby clogged the economic mechanism through which changing wage-levels affected the occupational and geographical redistribution of labour. The general effect of inter-war developments in unemployment maintenance has been to remove one set of incentives to work without replacing it by another, and in Great Britain we have only now, in the White Paper, faced the fact that we need something to take their place.

The mobility of labour is of course only one aspect of the problem of productivity or of full employment, but Mrs. Williams does not suggest that the price of social security is something to be paid by employee or employer only in the acceptance of compulsion or direction in peace-time. Equally important is the analysis, in her next two chapters, of labour control in war-time in Britain and of labour control in Germany and the U.S.S.R., which leads to the exposition in her final chapter of the administrative spade work that must precede any attempt to perpetuate labour controls in peace-time. The price of social security has to be paid in sound administration as well as in the acceptance by the individual of restrictions on freedom of choice of occupation, until the sense of social obligation is as powerful, and as unconsciously accepted, as is an underlying principle of conduct such as self-interest.

Despite Mrs. Williams' pragmatic approach to her subject, she is stronger at analysis and in defining the problem than in constructive suggestions for dealing with it. She stresses the importance of the educational approach to the development of new incentives, and senses the opportunities in the Government training centres, the Army Bureau of Current Affairs, the employment exchanges and the joint production committees, and her clear exposition makes the book highly stimulating to the imaginative reader. Much more might be done, as she indicates, in the way of vocational selection by utilizing the data in this field now being accumulated in the Forces. Again, Mrs. Williams points out that compulsory transfer to other jobs involves acceptance by the State of some measure of responsibility for welfare arrangements and wage standards.

The best part of this chapter is that in which, developing further ideas she has already voiced in the chapter "The Staff Problem" contributed to the volume "Social Security" edited by W. A. Robson, she discusses the reform of the Civil Service, which must also form part of the price of social security. Constructive long-term thinking and the exercise of the newer mental disciplines, she urges, is a Government function of the first importance. Here again, in pleading the importance of intelligence and statistics as a prelude to scientific policies based on known facts, she is in line with the White Paper; but in analysing the requirements of a Civil Service capable of integrating the work of the Ministries with the wider life of the community, she sees that it is not only in the Civil Service that reform is called for: a high standard of Ministerial statesmanship, she says, is the essential foundation of successful Government control, whether of labour mobility or of any other communal activity.

The similarity of thought and argument here is very close indeed to that of a recent admirable article in the *Political Quarterly* on "Government Administration and Efficiency" in a series on the post-war machinery of government. The analysis is of special interest in view of the recent report on the training of Civil servants, and elaborates further some points that are imperfectly covered in that report. In a single paragraph, Mrs. Williams anticipates a number of the more important recommendations of the report, but on the whole, within the limits of her argument, she is even more searching and suggestive.

This, then, is a book that is well written and should be well read. It has merits as a mere chronicle of developments in a comparatively limited economic field. It is even more valuable in its suggestions as to the way in which such institutions as industry, the trade unions and the Government machine must adapt themselves to the new functions that must be covered in an attempt to establish full employment and social security. For the rest, it has claims on the interest of the scientific worker as indicating what is involved in the elaboration of scientific policies and the application of the scientific method in human affairs. Further, within the limits to which she confines herself, Mrs. Williams has given a modest but no less admirable stimulant to the constructive thinking about the organization and administration of social and economic institutions on which the development, if not indeed the survival, of our democratic system depends. R. BRIGHTMAN.

A NATURALIST IN THE HIGHLANDS

Highland Naturalist

A Gamekeeper's Observations and Discoveries. By Dugald Macintyre. Pp. 240+8 plates. (London: Seeley, Service and Co., Ltd., n.d.) 12*s*. 6*d*. net.

DUGALD MACINTYRE is a Highland naturalist who has made his name as one of the leading observers of his time. He has during his long life had unusual opportunities for recording the habits of bird, beast and fish, and in him is the rare combination of the accurate recorder and the man who can set down clearly, simply and truthfully what he has seen and heard. Therefore, any book by Dugald Macintyre is of value.

In this volume the author weaves his observations into a number of short chapters. In each chapter is told the story of the life-history of some bird, animal or fish, and in that story are embodied the author's own observations.

We read (p. 80) of a gannet which, when diving for fish, pierced a guillemot right through with its sharp bill. Unable to rid itself of the dead guillemot, the gannet drifted about and finally came ashore exhausted, when a good human friend cut away the guillemot and thus saved its life. We read of a white grouse which, although a cock bird, was flushed from a nest he was making, while his mate had laid her first egg in her own nest close by. We read (p. 98) of the old white grouse actually dying as the author passed—falling from his roosting place on the steep hill-face and rolling past Dugald Macintyre in the dusk of a frosty winter's evening. The author attributes the old grouse's death to heart failure following on grouse disease. There are statements in this book which are difficult to check, and which in a naturalist of less standing might be looked upon with reserve. But in one of his earlier statements, no less surprising, Dugald Macintyre has been fully vindicated. It was in March 1913 that he wrote to the *Field*, saying that the common curlew was in the habit periodically of ejecting the lining membrane of

its gizzard by coughing. These lining membranes are light yellow pouch-like objects with the consistency of thin rubber, rolled up by the muscular coat of the gizzard wall before ejection. To Mr. Macintyre falls the credit of being the discoverer of this curious habit, now well attested.

The author, in a short chapter on the kite, suggests that it might be possible to reintroduce this bird into Scotland by placing its eggs in buzzards' nests. It is possible that, were a sufficient number of kites' eggs available, this might be done, but in Wales, the last nesting haunt of the species in Britain, the kite is still so scarce that I am very doubtful whether a clutch of eggs would be spared for the experiment. That is also the difficulty in the re-introduction of the osprey in the Highlands—the rareness of its eggs. Were some wealthy ornithologist to transport by air after the War a clutch of fresh osprey's eggs from Scandinavia to Scotland, and were these eggs to be placed in a nest of a buzzard already earmarked for this purpose, a brood of ospreys might be reared that would re-populate some Highland loch where the species formerly nested.

Mr. Macintyre is a keen angler, which is not surprising when one remembers his distinguished Highland ancestry. He is familiar not only with salmon, sea trout and brown trout, but also with the fish of Highland sea lochs and of the Atlantic. He describes the life-history of a pollack (or lythe as it is named in Scotland) which when caught turned the scales at 19 lb. That is a great weight for a pollack, but the fishermen who at times fish for these strong fish around the ocean rock of Sgeir nam Maol, in the Minch off northern Skye (where the owner of an ocean-going yacht told me that he caught heavier lythe than anywhere else off the British coasts) say that a 20-lb. lythe is not unknown here. My heaviest lythe was just over 16 lb., and my wife caught one of 16½ lb., but recently these fish have been much smaller.

SETON GORDON.

COMMERCIAL FORESTRY IN THE UNITED STATES

American Silvics and Silviculture

By Prof. Edward G. Cheyney. Pp. x+472. (Minneapolis: University of Minnesota Press; London: Oxford University Press, 1942.) 30*s*. net.

PROF. EDWARD G. CHEYNEY has written in this volume a very useful and comprehensive compilation on the American aspects of the sylviculture of some hundred and fifty commercially important forest species. His book is said to be—and many will agree—the first attempt at treating this branch of forestry in America from the fully practical side. Sylviculture, he explains, has been developed in Europe as an art through centuries of experience with European species of trees. "Out of that experience has come a series of silvicultural patterns that can be useful in America when we have learned to adapt and apply them to our own species. In themselves the patterns mean but little. To use them we must have knowledge of the factors that influence the growth of trees in competition with each other, of the types in which American species group themselves, and of the silvical characteristics of our more important species." It has been the aim of the author to deal as fully as present information permits with his definition, and his book discloses how admirably he has carried out his object.

In connexion with sylviculture as gradually developed in Europe, the author correctly says that what he terms the sylvicultural patterns, that is, the various sylvicultural systems, will have to be adapted in order to apply them to American species. The recognition of this important factor applies, where forestry is one of the national assets, to almost every country in the world outside Europe. India would appear to be the first country to which this realization, through its Forest Service, came—but only after a period of years during which rigid copies of purely European practice had shown their fallibilities. In that country for many years past the sylviculturist has recognized the necessity of modifying and adapting to local and varying conditions the text-book definitions, perfectly sound ones for Europe, of the sylvicultural systems. It appears curious, therefore, that Prof. Cheyney, in the careful research and consideration he has given to his subject, should have apparently ignored the great amount of work carried out in this direction throughout India and Burma during the past forty years. It is the reviewer's belief that America could find some adaptations or modifications of the systems now adopted in India as forms of practical management which could be of use to conditions in parts of the country, especially in the transition from virgin forest to a forest under a correct and detailed management.

The book is divided into four parts. The first three are written as a text-book on forestry. Part 4 deals with the sylvicultural description of all the important species. In Part 1, sylvicultural factors are dealt with. Part 2, which is very informative, discusses the forest regions of the United States under forests of the Northern Region, forests of the Appalachian Region, forests of the Atlantic and Gulf Coastal Plains, forests of the Lake States, forests of the Rocky Mountains, forests of the Northern Pacific Coast and forests of the Southern Pacific Coast. Part 3 treats of sylviculture in its elementary aspects, the sylvicultural systems, the application of the systems to the various forest types, thinnings and the disposal of slash. In Part 4 the species of trees given alphabetically are dealt with under range, types and associates, soil, moisture, light, and seed-production, growth management and resistance (to fire, pests and so forth).

In America, Prof. Cheyney's book is hailed as the first attempt to place sylviculture in its application to a correct management of the forests in its practical position. "His book deals with American sylviculture and constitutes the only discussion of its kind."

It is rightly said that the natural forests of the United States have contributed greatly to the country's development. It is equally true that in the past they have been greatly and often ignorantly exploited by the lumberman, with at times disastrous after-effects. Unfortunately this type exploitation has not ceased. "In the first year of World War II," it is said, "three-fourths of the entire cut lumber of the United States was absorbed by the War effort. All this indicates the immediate need for better forest management." In spite of the above statement, paper stocks are obviously still fairly abundant, for Prof. Cheyney's book is beautifully got up and is illustrated by many photographs lent for the purpose by the United States Forest Service.

E. P. STEBBING.

On the Influence of Trades, Professions, and Occupations in the United States, in the Production of Disease

By Dr. Benjamin W. McCready, 1837. (Publications of the Institute of the History of Medicine, the Johns Hopkins University, Fourth Series: Bibliotheca Medica Americana, Vol. 4.) Pp. vii+129. (Baltimore, Md.: Johns Hopkins University, 1943.) 1.75 dollars.

THE study of industrial diseases is a subject which, for obvious reasons, received little attention from medical men until comparatively recent times. Bernardino Ramazzini's "De morbis artificum diatribum" of 1700 was the first comprehensive work on occupational diseases, and the second was that of Thackrah of Leeds published in 1831. This latter work and the growth of industrialization in the United States of America influenced the Medical Society of the State of New York to propose for a prize essay in 1835 the subject of "The influences of trades, professions and occupations in the United States in the production of disease". The winner of the prize was a twenty-three year old physician, Benjamin W. McCready, and his essay was first published in 1837. This book contains the original essay with a critical historical introduction by Genevieve Miller.

The essay consists of four sections, discussing thirty-one employments. The first deals with outdoor workers in agriculture, on canals and railways, labourers and seamen; the second describes the workers in the textile industry; the third deals with artisans and tradesmen; and the fourth with the professional men.

McCready saw that in many cases the industrial hazards of his day were caused as much by basic habits and environmental conditions as by any immediate dangers in the occupations. The remedies he proposed were simple—proper housing and ventilation, personal cleanliness, shorter working hours and more exercise.

The editor and publishers are to be congratulated on their reproduction of this important historical document.

Civilization and Disease

By Prof. Henry E. Sigerist. Pp. xii+255+29 plates. (Ithaca, N.Y.: Cornell University Press; London: Oxford University Press, 1943.) 22*s*. 6*d*. net.

DISEASE has played a great part in the evolution of civilization. Dr. Sigerist develops the theme and demonstrates the interrelationship in its many aspects in the course of human history. He begins by describing the influence of external factors of living conditions, clothing, lighting and nutrition on the genesis of disease, and then passes on to particulars. Economic and industrial changes and their effects on the character of disease are illustrated by reference to the works of Ramazzini, McCready and Thackrah. The position of the sick in society has greatly changed from the earliest days, when they were ostracized as in the case of lepers or horribly confined if mentally ill. In the complex modern society, many sick persons can usefully be employed in selected occupations.

The law appears in the establishment of quarantines, in the licensing and regularization of medical practice, and in public health and industrial organization.

The course of history has at all times been subject to influence by disease in epidemic form, and reference is made to the effects of plague, typhus and malaria on the results of battle and on distribution of population.

Towards the end, Dr. Sigerist becomes discursive and sketches over the relationship between religion, metaphysics, science, the arts and disease.

The subject-matter of this book was first used as a series of lectures, and this is apparent in the style. The wideness of scope and paucity of detail make this very readable book more suitable for the sociologist and lay reader than for the student of the history of medicine. The volume is beautifully produced, and has excellent and interesting illustrations.

Thermionic Valve Circuits

By Dr. Emrys Williams. Second edition. Pp. viii+207. (London: Sir Isaac Pitman and Sons, Ltd., 1944.) 12*s*. 6*d*. net.

THE first edition of this book was reviewed in *Nature* of July 18, 1942. According to the author's preface: "The appearance of a second edition of this book has been hastened by the extensive consumption of the first edition by the enemy Luftwaffe". The opportunity has been taken to increase the size by some 15 per cent, by a general expansion of the existing chapters. New material has been added dealing with such subjects as frequency modulation, gas-filled valves, time bases, the Kipp relay, the transitron and the cathode follower; but the author has rightly resisted any inclination to go too far in meeting the general criticism of incompleteness. The book remains a very good survey of all the main types of valve circuits, presented in such a way that the student may be in a position to understand, or even foresee, further developments.

Pacific Ocean Handbook

By Eliot G. Mears. Pp. viii+192. (Stanford University, Calif.: James Ladd Delkin, 1944.) 1 dollar.

PROF. ELIOT G. MEARS, professor of geography in Stanford University, set himself a formidable task in compressing into less than two hundred small pages a survey of the current scientific knowledge of the Pacific Ocean and its adjacent lands. There are chapters on the structure of the basin, its islands, on the physical aspects of the waters including drifts and currents, and on every aspect of the climate and particularly the storms. Other chapters deal with navigation, magnetism and tides. All sections are amply illustrated with maps. When such a degree of condensation is demanded, minor slips are unavoidable; but on the whole the little volume is most informative on the scientific side and includes results of much recent work. There are also statistical appendixes and a folding map.

Textbook of Histology for Medical Students

By Dr. Evelyn E. Hewer. Third edition. Pp. xii+364. (London: William Heinemann (Medical Books), Ltd., 1944.) 17*s*. 6*d*. net.

THE essentials of normal histology are simply stated in this short text-book. The illustrations are excellent, and the photomicrographs by E. V. Willmott deserve special mention. As a laboratory reference book for medical students engaged on practical histology or preparing for examinations, this could not be bettered.

SOCIAL AND INDUSTRIAL INSURANCE IN GREAT BRITAIN

ALMOST two years after the publication of Sir William Beveridge's report on Social Insurance and Allied Services, the Government has issued two White Papers, Part 1 dealing with its proposals for social insurance generally (except for industrial injury) and for family allowances, and Part 2 with proposals for replacing the existing system of workmen's compensation by a new scheme of industrial injury insurance. The whole scheme follows the lines indicated by Sir William Beveridge more closely than the prolonged delay had led many to expect.

Social Insurance

In introducing the proposals for social insurance (Part 1)* the White Paper states that the Government accepts as necessary prerequisites to an improved and comprehensive plan of social insurance the three assumptions on which the Beveridge plan was based: institution of a scheme of children's allowances; framing of a comprehensive health service; and the avoidance of mass unemployment. Proposals for a national health service have already been published, and the Government's policy for maintaining a high and stable level of employment after the War has been set forth in the White Paper on Employment Policy. Those for a scheme of family allowances are included in the present paper.

These proposals are based upon two principles: first that nothing should be done to remove from parents the responsibility of maintaining their children; and second, that it is in the national interest for the State to help parents to discharge that responsibility properly. The scheme is not intended to provide full maintenance for each child but is a general contribution to the needs of families with children. This purpose, in the Government's view, can best be attained if a substantial part of the benefit is given in kind, and the school meals and milk services will therefore be extended to make them available to pupils in primary and secondary schools in receipt of grant from the Ministry of Education or the Scottish Education Department. These benefits in kind will be free of cost to the parents and will be available to all children in a family attending school, including the first.

The cost to public funds of supplying meals and milk to children at school when the service has reached its full development is estimated at about £60 millions a year. While accepting the argument in the Beveridge Report that children's allowances should be non-contributory and met wholly out of taxation, and that no allowance should be paid in respect of the first child, the Government rejects the rate of 8*s*. a week suggested by Sir William Beveridge and proposes a weekly cash allowance of 5*s*. for all children after the first below school-leaving age and remaining at school until July 31 following their sixteenth birthday. When the parent is receiving benefit, 5*s*. will be added to the benefit in respect of the first child.

With the exception of this family allowance scheme, the Government has adhered to the principle that freedom from want must be achieved in the first instance by social insurance: benefits must be earned by contributions. It has also decided not only to increase the range and amount of benefits provided, but that the scheme as a whole shall embrace the entire population. Of the six fundamental principles on which the Beveridge plan was based, the Government has adopted five: flat rate of contribution; flat rate of subsistence benefit; unification of administrative responsibility; comprehensiveness; and classification. There has been no attempt to vary contributions with the earnings of those who make them: broadly, the principle adopted has been that of equal benefits for equal contributions. Contributors and beneficiaries are classified into six groups, differing in respect of the benefits they need and the contributions they must make to receive them. Adopting the principle that the administration of a single, comprehensive, universal scheme of social insurance must be unified and that the various unco-ordinated sections of the system of to-day must be brought within a single administrative framework, the Government proposes the establishment of a Ministry of Social Insurance responsible for the whole of social insurance. The administration of assistance will be kept separate from that of insurance, though the Minister of Social Insurance will be responsible to Parliament for both. The present responsibilities of public assistance authorities for the payment of assistance in cash will be transferred entirely to the Assistance Board.

The Government has not accepted the sixth principle of adequacy of benefit. In fixing the rates of benefit, the Government considered whether it would be practicable to adopt a subsistence basis for benefits, but has rejected this as impracticable on the ground that the linking of benefit to subsistence-rates might involve the frequent variation of benefit-rates in accordance with the cost of living, and also that social insurance must necessarily deal in averages of need and requirement. A high level of benefit must mean a high level of contribution, and the Government concludes that the right objective is a rate of benefit which provides a reasonable insurance against want and at the same time takes account of the maximum contribution which the great body of contributors can properly be asked to bear. There still remains the individual's opportunity to achieve for himself in sickness, old age, and other conditions of difficulty a standard of comfort and amenity which it is no part of a compulsory scheme of social insurance to provide. In reserve there must remain a scheme of national assistance designed to fill the inevitable gaps left by insurance, and to supplement them where an examination of individual needs shows that supplement is necessary. There is no reference to a unified means test as advocated in the Beveridge Report, but the supercession advocated in the latter of the present system of approved societies is accepted: the Government concludes that it is not practicable to retain 'approved societies' either as independent financial units or as agents in the administration of the scheme. The considerations leading the Government to this conclusion and the alternative proposals of the Report, together with the wider proposals submitted on behalf of the approved societies, are summarized in Appendix II of the White Paper.

The scheme proposed by the Government is compulsory and includes everybody. The population will be divided into six classes: employees; the self-employed; housewives; adults who do not earn; children; and people over working age. It thus applies to large categories not hitherto covered

* Social Insurance. Part 1. (Cmd. 6550.) Pp. 64. (London: H.M. Stationery Office, 1944.) 6*d*. net.

by insurance; for example, those living on earnings gained otherwise than by salary or wages, or on earnings above £420 a year or on private income, and those employed in professions or industries hitherto specially excepted. Each insured person will pay a single weekly contribution for all benefits in the form of one stamp on a single document. For employed persons the stamp will also include the contribution for insurance against industrial injury. The first, second and fourth will be the contributing classes, and the rates of weekly contribution for persons over 18 (covering for Class I the benefits under the Industrial Injury Insurance Scheme as well as the Social Insurance Scheme) will be:

	Class I			Class II	Class IV
	Insured Person	Employer	Total		
Men:	s. d.	s. d.	s. d.	s. d.	s. d.
Aged 18 and over	3 10	3 1	6 11	4 2	3 4
,, 16–18	2 5	2 1	4 6	2 9	2 2
Women:					
Aged 18 and over	3 0	2 5	5 5	3 6	2 8
,, 16–18	2 0	1 7	3 7	2 5	1 10

There will be a standard rate of benefit of 40*s.* a week for a married couple and 24*s.* for a single man or woman, with lower rates for those less than 18. Sickness benefit will end after three years of continuous disability, and invalidity benefit at the standard retirement pension will be substituted. Unemployment benefit will be paid up to a limit of thirty weeks in a continuous period, together with additional days where the contributor has a good record of employment. After the end of either benefit, further contributions must be paid before an insured person can re-qualify for benefit. Special allowances at a higher rate will be available to persons undergoing a course of approved training, but such training allowances will not form part of the social insurance scheme but will be paid out of taxation. There is no condition, as in the Beveridge plan, of unemployment benefit being subject after a certain period to attendance at a work or training centre, and this, like the limitation of benefit, is a marked break from Sir William Beveridge's proposals.

With regard to the self-employed, the difficulties of securing effective control over the payment of benefit are emphasized, as in the Beveridge Report, but the Government proposes to pay benefit to Class II contributors after four instead of after thirteen weeks, and to excuse payment of contributions during those four weeks. An additional allowance of 16*s.* a week will be paid to those on single benefit who have an adult dependant. There will be a standard rate of retirement pension of 35*s.* for a married couple and 20*s.* for a single person. These rates will take effect from the commencement of the scheme instead of starting at 25*s.* and 14*s.*, respectively, and increasing to the full rate of 40*s.* and 24*s.* after twenty years as recommended in the Beveridge Report. The pensionable age will be sixty-five for men and sixty for women, but the joint pension will become payable when the husband qualifies, provided that if the wife is less than sixty years old, she is not gainfully occupied. Pensions will be paid only to those who have retired and will be reduced if more than 20*s.* weekly is earned during retirement. They will also depend on contributions paid during the working life of the applicant, and will be reduced when the contribution record shows a deficiency. Pensions will be increased by 2*s.* a week (joint) and 1*s.* (single) for each year of work after retirement age. Special arrangements will be made covering persons already pensioned or insured when the scheme comes into operation.

For married women, additional benefits will be available, subject to certain qualifying conditions, in a maternity grant of £4, maternity benefit at the rate of 36*s.* a week for thirteen weeks for gainfully occupied women, provided that occupation is given up for that period, or for women not eligible for maternity benefit, an attendant's allowance of £1 a week for four weeks. Special provisions will enable married women to insure for a personal retirement pension of 20*s.* a week in lieu of their share in a joint pension, and enabling married women earning more than 20*s.* a week to insure for sickness benefit at the rate of 16*s.* a week and unemployment benefit at 20*s.* a week. The main provisions for widows will be a benefit of 36*s.* a week, with 5*s.* added for the first child, during the first thirteen weeks of widowhood. Thereafter, if there is a dependent child, a guardian's benefit of 24*s.* a week, with 5*s.* added for the first or only child, and a widow's pension of 20*s.* a week to widows who are fifty or over when the husband dies or when the children cease to be dependent, provided ten years have elapsed since the marriage. These benefits will terminate on remarriage, and the last two will be reduced for substantial earnings.

Death grants will be paid at the rates recommended in the Beveridge Report according to the age at death, but an age limit of sixty-five instead of sixty is proposed, when one grant will be paid at the beginning of the scheme, and for persons then between fifty-five and sixty-five the grant will be £10. Such questions as insurance for indirect expenses connected with funerals are reserved for separate examination. Sickness and invalidity benefit, maternity benefit, widow's benefit, guardian's benefit, widow's pension and retirement pension will be reduced by 10*s.* a week during maintenance in hospital after the first twenty-eight days of such maintenance. Not more than any one social insurance benefit or pension will be payable to an individual at any one time.

Apart from the question of workmen's compensation, the Government in its scheme has accepted outright sixteen out of the twenty-three changes proposed in the Beveridge Report; and with modification or reserve two of the others. Essentially the scheme may be described as on a practical basis. The refusal to make disability benefit indefinite in duration or unemployment benefit at full rate indefinite in duration but conditional on attendance at a work or training centre after a limited period, like the rejection of a subsistence basis for benefits, shows that the Government has not adopted the basic philosophy of the Beveridge Report; but there can only be the warmest welcome for proposals which sweep away so many anomalies, and simplify and unify administration and rates of benefit and contribution. It will be noted that the administrative organization outlined is framed to meet the position at the beginning of the new scheme, and that it is proposed to review the position when the scheme is in operation and administrative policy clearly defined and established.

Industrial Insurance

Whatever slight disappointment may be felt in some quarters with the Government's proposals for social insurance as lacking the boldness of the original Beveridge Report, and keeping more strictly to the

actual abolition of want, no charge of lack of boldness can be brought against the proposals for an industrial injury insurance scheme outlined in the White Paper issued as "Social Insurance. Part 2: Workmen's Compensation"*. The need for radical reform of the present situation is frankly accepted, and the proposals advanced are in some respects an improvement on the Beveridge scheme. They are intended to avoid the main weaknesses and difficulties of the existing system and to remove workmen's compensation from the atmosphere of controversy and conflict with which it has been surrounded and establish it on a happier and sounder foundation.

The White Paper gives first a concise summary of the present system of workmen's compensation in Great Britain, first established in 1897, followed by a survey of the proposals on this question in the Beveridge Report and a concise statement of the Government's views. Generally, the Government endorses the criticisms of the existing system made in that report. In particular, it considers that the Beveridge scheme is too complicated and allows too much scope for contention between the workman (or his trade union) and the employer (or the insurance company or mutual association with which he is insured); it thus tends to retard the workman's recovery and to prejudice good relations between him and his employer. The Government considers it essential to provide that, in future, claims should be made on an independent authority and settled by a procedure less liable to give rise to friction. Accordingly it reaches the general conclusion that the present system should be replaced by a new scheme, the general structure of which should be based on the accepted principles of social insurance.

Proceeding on this basis, the Government agrees with the proposals in the Beveridge Report that the new scheme, broadly speaking, should apply to all persons working under a contract of service, including non-manual workers, and without any income limit; that the cost should be borne by a central fund maintained by contributions from employers and workmen, with a contribution from the Exchequer; that claims should be dealt with by administrative rather than legal procedure; and that the responsibility for the general administration and supervision of the working of the scheme should rest on the authority responsible for the general scheme of social insurance. It is unable, however, to accept four of the main proposals of the Beveridge Report for the reasons indicated below.

First, the Government does not think it right to limit special rates of benefit for long-term disability to cases of more than thirteen weeks duration. Such cases constitute not more than 10 per cent of the total, and the Government thinks the advantage claimed for unification of rates during an initial period is exaggerated. Secondly, the proposal to relate industrial pensions for long-term disability to the earnings of the workman before the accident in cases of total incapacity, and to his earnings both before and after the accident in cases of partial incapacity, is regarded as contravening the principle that there should be differentiation in benefits only according to family responsibilities, and that subject to provision for such responsibilities, there should be uniform flat rates of benefit in return for uniform flat rates of contribution. Further, the assessment of workmen's compensation by reference to earnings has given rise to serious difficulties and objections which are considered in some detail in the White Paper.

The Government therefore proposes to adopt two entirely new features for the assessment of industrial pensions: (*a*) to provide, in accordance with the generally accepted principle of social insurance, uniform flat rates of pension without regard to pre-accident earnings, but taking account of family responsibilities; and (*b*) to give benefit according to the degree of disablement due to the injury in the same way as is done under war pensions schemes, through assessment by a medical board of the condition of the workman resulting from the injury as compared with the condition of a normal healthy person of the same age and sex. This principle has the advantage of getting rid of the distinction hitherto drawn between total and partial incapacity for work, and giving the workman who has suffered an injury causing permanent or prolonged disablement a pension commensurate with the assessed degree of disablement, irrespective of his earning capacity. It eliminates as a cause of dispute the questions whether or to what extent the workman has recovered his earning capacity. It removes the grievance that an improvement in earning capacity results in an automatic reduction of compensation, and avoids any ground for suspicion on the part of the workman that he is being pressed to return to unsuitable work with a view to such reduction, and the fear that if he returns to work he will jeopardize his right to further compensation. It should also remove any hesitation he may feel in submitting to a course of rehabilitation treatment and thus promote a speedier recovery, while it helps to meet the complaint that no compensation is paid for mutilation or disfigurement except in so far as it causes loss of earning capacity.

Thirdly, the Government does not agree with the proposal in the Beveridge Report that special provision in fatal cases resulting from industrial accident or disease should be by way of the grant of a lump sum. Such payments, even if administered under strict control, are not a satisfactory method of assuring an income, and the Government considers that provision for dependants in fatal cases should be by way of pension or weekly allowance. Fourthly, the Government does not accept the proposal that a substantial part of the fund for payment of benefits should be found by means of a special levy on employers in the hazardous industries. This proposal constitutes a departure from the complete pooling of risks adopted generally in other branches of social insurance. "Hazardous industries are not hazardous because employers in them are less active in the prevention of accidents than other employers, or because the workmen in those industries are less careful than other workmen. They are hazardous because of the nature of the employment and the inherent risks." The Government questions the value of the incentive to the prevention of accidents ascribed to the merit rating system suggested in the Beveridge Report, and considers that for further progress in this matter we should look to the development of the standards set up under the factories, mines and other safety enactments, and to the increase of co-operation between employers and workmen. On the other hand, the Government would welcome the establishment of joint bodies for dealing with safety questions—either statutory or voluntary —in all industries where there are substantial risks

* Social Insurance. Part 2: Workmen's Compensation. Proposals for an Industrial Injury Insurance Scheme. (Cmd. 6551.) Pp. 32. (London: H.M. Stationery Office, 1944.) 3*d*. net.

of industrial accident and disease. It also agrees with the recommendation in the Beveridge Report that an inquiry is desirable into the relation, both in industrial and non-industrial cases, between claims to security benefit and claims for damages in respect of personal injury caused by negligence, and also a review of the law governing the liability of employers and third parties to pay damages or compensation to workmen, or their legal representatives and dependants, independently of the provision for them proposed in the new scheme; the Government has set up for this purpose a committee with comprehensive terms of reference under the chairmanship of Sir Walter Monckton.

The remaining features of this new scheme to treat workmen's compensation not as part of the law of employer's liability but as a social service may be briefly summarized as follows. The scheme will be comprehensive, will not provide for 'contracting out' schemes and will apply to accidents arising out of, and in the course of, employment and to specified industrial diseases. The liability, instead of being on the individual employer, will be placed upon a central fund out of which all benefits, both in disablement and fatal cases, and administrative charges will be paid. The fund will be maintained by weekly contributions from employers and workmen collected by stamp, with a contribution from the Exchequer. The weekly rates of contribution will be 6*d*. for adult men and 4*d*. for women, to be shared equally between the employer and workmen, with half these rates for juveniles. Benefits will not depend on a contribution qualification. The scheme will be under the general charge of the Minister of Social Insurance, with an advisory committee or council, on which employers and workmen will be equally represented, to advise the Minister on important matters of policy and administration referred to them. Employers and workmen will be equally represented on the local appeal tribunals.

The present procedure by which the workmen's claims against employers are subject to appeals to courts of law will be superseded by a system under which claims will be dealt with by a pensions officer, subject to rights of appeal to local tribunals, and further rights of appeal to an industrial injury insurance commissioner whose decision will be final. In disablement cases the benefits will be at uniform flat rates. They will consist of an industrial injury allowance payable for an initial period while the workman is incapacitated for work, to be replaced, where the disablement is likely to be permanent or prolonged, by an industrial pension which will be supplemented by a special allowance if the pensioner is unemployable. Allowances will be given for family responsibilities, and treatment allowances and allowance for constant treatment in certain circumstances. No provision will be made for commutation of the pension by a lump sum payment, but where the injury results in only a minor degree of disability, provision will be made for a final settlement by an award of a gratuity or of a temporary allowance at a special rate with or without a final gratuity. In fatal cases the scheme provides for payment of a pension to the widow with an allowance for the first child, and a higher rate of allowance where the first child is an orphan. Provision will be made, in certain circumstances, for payment of a pension to one or both parents, or where no widow's or parent's pension is payable, to one adult dependent member of the deceased workman's family.

PROBLEMS OF MODERN PHYSICS*†

By PROF. J. FRENKEL

The Atomic Nuclei, Elementary Particles and the Nature of Matter

Nuclear physics emerged as a new independent science when, ten years ago, Cockcroft and Walton, working on a suggestion by Rutherford, first used protons artificially accelerated to immense velocities for bombarding other heavier atoms. Before that time, work of this kind had only been done with the help of radioactive substances, atoms of which are transmuted spontaneously without any outside agent, with the expulsion of alpha-particles (that is, helium nuclei) or beta-particles (fast electrons). These alpha- and beta-particles can be used to transmute artificially stable atomic nuclei. This method still has its value, and with its help (by bombarding beryllium with alpha-particles emitted in the natural radioactive disintegration of polonium) it was shown that besides protons (hydrogen nuclei) complex nuclei contain also neutrons. These are particles similar in mass to protons but having no electric charge. To obtain neutrons in the free state, nuclear physics has begun to use clusters of protons or deutons (nuclei of heavy hydrogen). These are accelerated to speeds corresponding to energies of some tens of millions of volts, by special apparatus such as the cyclotron, which was invented in the United States by E. O. Lawrence in 1930.

By such methods it has been possible to cause and study a large number of nuclear reactions of the type

$$A + B \rightarrow C + D,$$

where A and B are the initial nuclei and C and D the resulting ones. These 'alchemical' reactions are in many respects similar to ordinary chemical reactions; but they differ above all in the very much larger energy balance involved (as a matter of fact it is some million times larger). As a rule, one of the reacting particles (A or B) is a very simple nucleus, such as a proton or deuton, or in the limiting case a helium nucleus, and the other is a complex nucleus. Thus the reaction $A + B \rightarrow C + D$ is usually treated as the artificial disintegration of the nucleus A by the particle B (a proton, for example), which leads to the expulsion from it of the particle D (say a neutron). Really this reaction results in the union of A and B into a complex nucleus (AB), which is in an unstable, excited state, and so spontaneously splits up: $AB \rightarrow C + D$.

Like chemical reactions, these transformations can be either endothermic or exothermic. If A and B have a charge of the same sign, the stage $A + B \rightarrow AB$ requires a definite amount of energy for its initiation, and this is supplied by the kinetic energy of the bombarding particle B. This energy is needed to overcome the coulomb repulsion between the two particles. It is as if the nucleus A were surrounded by a protective rampart in the form of a 'potential barrier' of tens of millions of volts, and if the motion of material particles were governed by the classical laws of mechanics then the particle B would have to have kinetic energy at least as great as the height of this potential barrier in order to get past it. In

* Translated by E. R. Holmberg from *Vestnik Acad. Sci., U.S.S.R.*, 4–5 (1943), made available by courtesy of the Science Section of the Society for Cultural Relations with the U.S.S.R.

† Continued from page 421.

actual fact, the penetration of B into A which leads to the formation of a complex nucleus AB is possible when B has appreciably lower energies than this. This is due to a peculiar quantum effect known as the 'tunnel-effect'. However, the probability of this 'tunnel-effect' falls off very rapidly as the kinetic energy of B decreases. For example, if the height of the potential barrier around A is ten million volts and B has a kinetic energy of one million volts, then only one such collision out of about ten thousand will result in A and B uniting. (At very small separations the coulomb repulsion between the nuclei is swamped by a force of attraction of a different kind about which we shall speak later.) So in spite of the tunnel effect, the reaction $A + B \rightarrow AB$ is for practical purposes associated with a definite activation energy; that is to say, the reaction can only take place when B has kinetic energy greater than a definite value.

This position is accentuated when a particle B travels through a solid body composed of atoms of A, for B interacts with the electrons surrounding the A nuclei and is thus rapidly slowed down. Since both the nuclei A and the particle B are extremely small, B does not as a rule collide with an A nucleus during the time it has a sufficient energy for an effective collision. As a result, such nuclear reactions occur very rarely, and out of many millions of B particles used to bombard the substance A, only one will produce the desired result. So in spite of the fact that in many isothermal nuclear reactions a huge amount of energy is given off per unit weight, the utilization of this source of internal atomic energy is impossible in practice because of the small numbers of the reacting particles. In answer to a question put to him on this subject by a newspaper correspondent four years ago, Einstein said, "It is exactly like throwing bricks at a raven—at night".

The developments of the last two or three years have, however, somewhat shaken this pessimistic point of view, and have once more prompted the hope that the problem of transmuting atoms on an industrial scale can be solved.

If for our bombarding particle B we use an uncharged body, a neutron in fact, then the activation energy becomes zero (because the neutron is not repelled by the nucleus A and can penetrate it with an arbitrarily small initial velocity); and what is more, the neutron does not interact with electrons, behaving among them just as it would in empty space. A free neutron moving through a material body must therefore eventually combine with a nucleus according to the formula $A + B \rightarrow AB$, and its efficiency is 100 per cent. Unfortunately, however, free neutrons are not encountered in Nature (and if they did exist we could not direct their motion). They can only be obtained by excitation of a nucleus by artificially accelerated charged particles, that is, with the help of the reaction $A + B \rightarrow C + D$ (where B denotes a proton, deuton or alpha-particle, and D a neutron) which, as we have just seen, is very inefficient.

In 1939 a new reaction was discovered which involves the division of a nucleus of uranium brought about by slow neutrons. The uranium nucleus is at the limit of stability (on account of its very high electric charge) and divides, under the influence of the shock imparted by the neutron, into two equal parts (rather like a liquid drop which has been highly charged), and these two parts separate with the colossal energy of about 200 million electron volts. From this reaction two or three neutrons are set free with sufficiently high energy to 'explode' other uranium nuclei. Thus the process can, in principle, become like an avalanche. To get this chain reaction, it is necessary first to separate from uranium, which is a mixture of three isotopes, the light isotope with atomic weight 235, which only makes up 0·5 per cent of the total. The trouble is that this light isotope is much more unstable than the ordinary 238 isotope, and tends to disintegrate before it can capture a neutron. This leads almost immediately to a rupture of the neutron 'chain'.

Before the beginning of the War, physicists of all countries were searching for a practical solution of the 'uranium problem', that is, to find a certain way of causing this chain reaction of uranium.

The solution of this problem would open to humanity a completely new technical perspective. It would provide a new source of energy, millions of times more abundant (for equal masses of fuel) than coal or petroleum, although not so widely distributed. There is no doubt that immediately the War has finished, the uranium problem will occupy a central place in experimental and technical physics.

In addition to this there will also be an intensification of the attack on the problem of obtaining charged particles, nuclei of hydrogen and helium, with much larger energies than have been hitherto achieved. In the United States, where at the present time there are eighteen powerful cyclotrons in operation, a gigantic new one was under construction at the beginning of the War, capable of producing charged particles with energies of 100 million volts.

At these energies the efficiency of the nuclear reactions (measured by the ratio of the number of neutrons liberated to the number of charged particles used to produce them) must increase to values many hundreds and perhaps thousands of times greater than those hitherto achieved. If this is so, then the reactions can be carried out on an industrial scale; and besides just utilizing the atomic energy, it may be possible to obtain by transmutation rare and costly elements from those widely distributed in Nature.

The rarest and most costly of all are the radioactive elements—radium, thorium, actinium and the radioactive products of their disintegration. By bombarding normal stable atoms with neutrons, it has been possible to obtain new unstable atoms—radioactive isotopes of practically any element. For this it is necessary to be able to produce a sufficient quantity of free neutrons.

The cyclotrons already in existence provide in a large measure the solution to this part of the problem. With their help it is easy to obtain artificial radioactive elements in quantities equivalent in the intensity of their beta- and gamma-radiation to tens of kilograms of radium. So it is obvious what great value these results have for medicine (some large American hospitals have their own powerful cyclotrons).

These artificial radio-elements have already been widely used as indicators in various physico-chemical and biological investigations (diffusion in solid bodies, assimilation of various substances in living organisms, etc.).

One of the current problems of modern nuclear physics is therefore to increase the efficiency of nuclear reactions by producing particles with energies of tens and hundreds of millions of volts.

The cyclotrons are capable of communicating very high energies to nuclei, but not to electrons. But bombarding nuclei with high-speed electrons with energies around ten million volts appears to be more

direct and effective than using protons, deutons, etc., for producing transmutations of atoms and artificial radio-elements. The first step in this direction has recently been taken, using relatively slow electrons. At the beginning of 1941, Kerst in the United States designed and constructed a simple piece of apparatus which produced a stream of electrons of practically any required energy. The application of these ultra-fast electrons and the ultra-hard gamma-rays they produce, to the transmutation of atoms, will be energetically studied by physicists of all countries as soon as the War ends.

Until now, we have considered the chief problems of nuclear physics from the experimental and engineering points of view. But there are no less alluring and important problems on the theoretical side, and their solution must lead to far-reaching changes in our conceptions of the nature of matter. These new problems arose some ten years ago when the neutron and positron were discovered, and although the respective discoveries of these two particles came independently of each other, they are from the theoretical point of view closely connected.

Until the discovery of the neutron, a complex nucleus was imagined as consisting of protons and electrons (the latter in smaller numbers to give the corresponding positive charge). The existence of electrons in the nucleus was proved, so it seemed, by the fact that the majority of radioactive elements emitted them in the form of beta-rays with an increase of one unit in the positive charge of the nucleus. From the other side, this theory led to a series of unsurmountable difficulties connected with the magnetic and other properties of the nucleus. All these difficulties were overcome when, after the discovery of the neutron, it was shown that it was possible that the nucleus contained no electrons but only protons and neutrons. This, however, raised new difficulties over the question of the production of the electrons which form the beta-rays. The final conclusion is that these beta-rays arise (in the same way as photons when light is emitted) on account of the instantaneous transformation of neutrons into positrons. This bold idea, now firmly established experimentally, was first advanced by D. D. Ivanenko.

From this, of course, it would be imagined that the neutron is not an elementary particle like a proton but something like an atom of hydrogen, consisting of a proton and an electron. This, however, conflicts with the fact, discovered by Joliot in 1934, that certain artificial radioactive nuclei (for example, the one formed by the fusion of aluminium with an alpha-particle) emit positive beta-rays consisting of positive electrons or positrons. Thus the proton can also be regarded as a complex particle made up of a neutron and a positron. Neither of these pictures Is true. Both the proton and the neutron are elementary particles in the sense that neither can be subdivided into still finer particles, although they can change one into another with the simultaneous appearance of an electron or positron. A very convincing argument, based on the law of conservation of energy and momentum, shows that during these transformations certain neutral particles like photons must appear. These have been named the 'neutrino' and 'anti-neutrino'. (In the opinion of some theoretical workers, a photon is equivalent to a pair of these particles.)

Now positrons were discovered by Anderson and Neddermeier completely independently of the neutron, during an investigation of cosmic rays and the influence of magnetic fields on their motion. It was found that a positron came into being with an electron and disappeared in company with another. The energy necessary for the formation of such an electron-positron pair is obtained through the annihilation of a photon; conversely, when a positron-electron pair disappears, one or two photons appear and carry off the energy.

These results, which have been confirmed many times during the past eight years by experiment (it has been found possible to use ordinary gamma-rays and X-rays instead of cosmic rays), have thrown up new fundamental problems for theoretical physics—problems about elementary particles.

In the nineteenth century, the elementary particles appeared to be the atoms. 'Matter', which made up material bodies, was regarded as a collection of immutable atoms of 92 different kinds.

At the beginning of the twentieth century, it was shown that the elementary particles were smaller than atoms, and that the properties of the various kinds of atom were due to the envelope of electrons. The next to be studied was the atomic nucleus, the simplest representative of which is the hydrogen nucleus. It appeared that physics had come to the end of the process of the analysis of matter, having shown that all material particles consisted of protons and electrons, and that all physical and chemical forces (apart from gravity) could be traced to electric forces.

From 1932 onwards, that is, from the moment the neutron was discovered, this simple but incorrect picture underwent enormous complication. Besides electrons there were positrons, and these and other particles did not appear to be immutable and indestructible but apparently could appear and disappear like quanta of light or photons. If the electrons in the atoms and material bodies appear indestructible, this is only because under normal conditions there are no positrons with which they can unite and so disappear, and also because, generally speaking, changes of protons into neutrons in the nucleus are energetically 'unprofitable' and therefore impossible.

The question arises, Is the indestructibility of protons and neutrons, apart from their mutual interchange, real or only apparent, like that of the electron? A number of demonstrations and experimental facts relating to the behaviour of neutrons and protons tends to show that they are in fact, in every respect except their mass, very similar to electrons. Therefore it seems very probable that, like electrons, they can in favourable circumstances appear and disappear in conjunction with their hypothetical opposites, the antiproton (that is, a proton with negative charge) and the anti-neutron.

If for the birth of an electron-positron pair we need the 'blow' of a particle (say, a photon) with an energy of one million volts, according to Einstein's law (product of mass and the square of the velocity of light) we need for the joint birth of a neutron or proton with its corresponding anti-particle a particle with an energy 2,000 times greater, that is, with an energy of 2×10^9 volts. At the present time, such particles are found only in the cosmic rays; so it is here that we must look for the phenomenon of the 'materialization' of neutrons and protons. Later on, when physics can produce artificially particles with energies around 10^9 volts, the process of creating neutrons and protons (together with their opposites) will be controlled just as to-day we can control the creation of electron-positron pairs (by using hard

X-rays). The demonstration and control of these phenomena are the most interesting problems of nuclear physics. Of course, the reality may turn out much more complicated than our scheme based on analogies with proton and neutron on one side and with electrons on the other. The method of analogy is usually limited, but even so it is usually very fruitful (as was shown, for example, in the development of the study of light and matter). It is quite possible, however, that besides neutrons, protons and their antilogues, we shall be able to create particles with mass, magnetic moment and other properties hitherto unknown.

Physics had scarcely recovered from the unexpected appearance of neutrons and positrons when in 1937 Anderson discovered a new type of elementary particle, called the mesotron or meson, in cosmic rays. These particles have the same electric charge as an electron or positron, but their mass is some 200 times greater than that of an electron, that is, about one tenth that of the mass of a neutron or proton. They come into being in the upper layers of the atmosphere as the result of some as yet unknown process of interaction between the primary constituents of cosmic rays (photons, electrons or protons) and atomic nuclei. Their life is only some millionths of a second, yet in this time they are able to pierce the surface of the earth and penetrate to a depth of some hundreds of metres. Finally, the mesons are destroyed by some form of radioactive disintegration into electrons and neutrons.

Apparently the mesons play an essential part in the creation of attractive forces between protons and neutrons at small distances (as, for example, when they are bound together in a complex nucleus). According to a theory put forward in 1936 (that is, before the discovery of the meson) by the Japanese physicist Yukawa, the attraction between neutron and proton can be described as due to a kind of 'ball game' during which fragments are emitted by one particle and absorbed by the other. From considerations of the radius of action of nuclear forces, Yukawa concluded that these fragments should be about 200 times more massive than an electron, and would therefore correspond to mesons. However, the development of Yukawa's theory into a general explanation of nuclear forces has not been completely satisfactory as yet.

The development of physics during the last ten years has given rise to numerous completely new and unexpected problems connected with the nature of matter. The conception that matter consisted of indestructible elementary particles with immutable properties has been shown to be false. True, we have not yet had direct experimental demonstration of the destruction of the heavier elementary particles such as protons and neutrons, but already the one fact of their mutual interchange (in the beta-decay process of radioactive substances) shows that they are no more permanent than electrons. To-day, the problem of matter is concerned not so much with the explanation of the properties of elementary particles as with the explanation of the circumstances of their appearance, disappearance and mutual interchange. There is also the fact that certain particles are not only material objects but also agents of transmission of force between other particles. Thus, for example, photons play the part of transmitters of electro-magnetic forces between charged particles (electrons, protons and mesons), and are tossed across the separating space like balls. As we have seen above, mesons play an analogous part in the transmission of non-electromagnetic 'nuclear' forces between nucleons, as protons and neutrons are called. It is possible that nucleons themselves will be shown to be agents of transmission for as yet unknown forces between unknown particles.

The material world, which a short time ago contained only protons and electrons, is beginning to be occupied by an increasing number of particles of ephemeral existence and the double role of sources and transmitters of force. It is not too much to think that with the use of more powerful sources of energy, physics will be able, starting with known particles such as protons and electrons, to discover or rather create new particles with completely different masses, mechanical and magnetic moments, and electric charges. Some of these will be unstable or radioactive like the meson, while others, like the positron, will be stable in the absence of their anti-particle with which they unite and disappear.

This picture of matter, painted by modern physics, appears fantastic at first sight. Actually it is only unusual in terrestrial conditions. In the interior of stars where temperatures reach millions of degrees centigrade, the picture would be completely normal. To-day it can be taken as established that the source of energy coming from the sun and other stars is a nuclear reaction (probably chiefly the formation of helium from hydrogen). A still more intense stream of energy comes from certain stars during a spontaneous process of explosion, which results in the formation of what is called 'nova'. The metamorphosis of matter which occurs in the interior of these stars leads to the emission of a huge quantity of energy.

Information about these distant cosmic processes comes not only from the rays of visible light emitted by stars, but also from the cosmic rays which traverse the earth's atmosphere and penetrate the earth itself to a depth of some hundreds of metres. At the limit of the earth's atmosphere and in the stratosphere, the cosmic rays consist predominantly of photons and charged particles, electrons, mesons and some protons with energies ranging up to 10^{16} volts. The mesons, as also apparently the electrons, arise at the edge of the earth's atmosphere. So the question of the original composition of the cosmic rays remains unanswered, like the question of the origin of these rays. Providing the answers is one of the current problems of modern physics and astrophysics.

The conception that matter consists of elementary particles is one-sided, although practically it is justified under terrestrial conditions with our comparatively meagre sources of energy.

The mutual interaction of material particles can be handled with the help of the concept of the dynamic field. To-day we know three kinds of such fields: gravitational, electromagnetic, and finally the recently discovered and as yet unnamed fields which characterize nuclear forces.

These fields extend continuously throughout all space, concentrating in the neighbourhood of material bodies and particles which give rise to them.

The fields due to separate particles can be combined into a 'resultant'. This raises the question of the action upon an individual particle of its own field, which was first posed by J. J. Thomson in connexion with charged particles. It was shown that to a first approximation the reaction of an electromagnetic field upon the particle producing it was formally identical with the force of inertia. Applying this result to a single electron, Lorentz showed that

the inertia or mass of the electron could be completely attributed to the reaction of its electric field, if the charge was supposed as concentrated in a sphere of radius 10^{-13} cm. According to this, the law of motion of an electron turns out to be equivalent to the statement that the electron moves so that the total force on it, as determined by the resultant field, is zero. This 'Lorentz principle' is equivalent to the conservation of energy, momentum and moment of momentum for any system of electrons if we associate these magnitudes not with the electrons themselves but with the electromagnetic fields they produce.

That the concepts of conservation of energy, momentum, and moment of momentum, which arose in the mechanics of moving particles, could be applied to the electromagnetic field, had been realized before Lorentz put forward his theory. It was, however, only after the inertia of the electron had been explained as the result of electromagnetic reaction that its kinetic and potential energy could be treated as the electric and magnetic energy of its field.

In this way the electromagnetic field was shown to be the vehicle of all the mechanical properties (energy, mass, momentum, etc.) which were earlier ascribed to material particles. The particles were thus considered not as sources of fields but as products of them—rather like knots in the lines of force. The question of the force of interaction between these 'knots', like the question of self-reaction, loses its meaning, as the resultant force experienced by each of them is zero. The laws of motion of the particles formed by the field agree completely with the law of conservation of energy and momentum of the field.

The further development of field theory concerns the solution of three types of problems: first, problems of the structure of electrons and the atomic nature of electric charge; secondly, the dynamics of nuclear fields; and thirdly, the quantization of dynamical fields.

The structure of the electron has been tackled hitherto from two angles, one treating it as a point charge and the other as if it had extension. Along both avenues of approach insuperable difficulties have been encountered. These difficulties, as also those connected with the atomic nature of the charge, will probably be solved by a thorough application of quantum theory ideas, but before this is possible we need further development of modern quantum mechanics.

The importance of the dynamics of nuclear fields is due to our ascribing the inertia of nuclear particles to the reaction of their own fields. The attempts which were made earlier to treat the inertia of protons as due to the reaction of their electromagnetic field lost their meaning when the neutron was discovered, for the neutron, even without electric charge, has a mass very close to that of the proton. In a number of papers to-day this non-electromagnetic mass is treated as a magnitude corresponding to some nuclear 'charge' bearing the same relation to the nuclear fields as the electric charge does to the electromagnetic field. The protons and neutrons themselves are thus regarded as 'knots' in a nuclear field, either apart from or in combination with an electromagnetic field.

From this point of view matter is a collection of interpenetrating dynamical fields, electromagnetic and nuclear, with material particles and bodies forming knot points. These points can under certain conditions appear and disappear, although the energy of the field, the momentum and other fundamental properties remain unchanged.

This picture is still only a provisional sketch. In order to complete it we need further development of the ideas of the quantum theory. The essence of this theory is an organic statistical synthesis of continuity and discontinuity. It was first introduced in the studies of the motion of particles and of light, and through the development of the quantum aspect of dynamical fields has helped enormously towards the solution of the problem of matter. As a result, new particles have appeared on the physics scene. These are in addition to those which create, or are created by, the known dynamic fields, and serve as vehicles of interaction between the original particles.

In the case of electromagnetic fields, for example, the sources, or if you like products, of which are electrons, the corresponding quantum particle, the transmitter of electromagnetic action is the photon. In the case of nuclear fields created by protons and neutrons, the corresponding quantum particle is apparently the meson. On the other hand, mesons, like electrons, take part in the creation of the electromagnetic field. This prompts the very natural thought that in a sense all particles are quanta with respect to some other particles. In particular, the electron positron pair could in all probability be treated as quanta of some as yet unknown field, which in its turn is created by other particles, for example, the nucleons. But the nucleons could play the same part in relation to other particles probably as yet undiscovered.

But here we are crossing the boundaries of modern physical science and risk falling into the realm of unscientific phantasy. Nevertheless, recent developments of physics have shown how limited and narrow our previous ideas about the physical world were, so in a survey of the problems of modern physics we need not fear a certain extension of its frontiers, even if it is not yet fully justified.

VALUE TO THE STUDY OF CHINESE CIVILIZATION OF COLLECTIONS AND MUSEUMS IN BRITAIN

By PROF. W. PERCEVAL YETTS, C.B.E.
Professor of Chinese Art and Archæology in the University of London

"AT no period in the history of the world has the attention of civilized nations been so fully directed towards China, its early history and modern position as at the present moment." These words, though true to-day, were in fact written exactly a century ago to preface the catalogue of London's first Chinese Exhibition. It was the enterprise of an American, named Nathan Dunn, who, during twelve years spent in China as a merchant, had collected the 1,341 exhibits, representing, so he claimed, "the Chinese world in miniature". More than fifty thousand persons visited his collection in a pavilion built for it near Hyde Park Corner. Presumably the exhibits were in due course shipped back to their owner in Philadelphia.

The next display of the kind remained in England and so contributed to the beginnings of our Chinese

PROCEEDINGS of the NUTRITION SOCIETY

Honorary General Editor: S. K. KON,
National Institute for Research in Dairying, University of Reading.

Proceedings of the English Group edited by
E. M. M. HUME
and
S. K. KON.

Proceedings of the Scottish Group edited by
E. W. H. CRUICKSHANK
I. LEITCH and
J. S. THOMSON

The proceedings of The Nutrition Society are being published in order to record the papers and discussions at the scientific meetings of the Society and to make this information available to those interested in developments in the scientific knowledge of nutrition and its application. For the time being 2 double numbers will constitute a volume. Volume 1 contains reports of meetings held during 1941 and 1942, and volumes 2 and 3 will deal with meetings held in 1943 and 1944.

CONTENTS OF VOLUME 1

Nos. 1 & 2

Foundation of The Nutrition Society.

Scientific Meetings:

The Evaluation of Nutritional Status. Cambridge, October 1941.

Food Production and Distribution in Relation to Nutritional Needs. London, February 1942.

Food Supplies in Relation to Human Needs. Part 1. Requirements for Health. Perth, March 1942.

Food Supplies in Relation to Human Needs. Part 2. Requirements in Terms of Food. Dundee, May 1942.

Problems of Collective Feeding in War time. London, May 1942.

Nos. 3 & 4

Scientific Meetings:

Dehydration of Foods and the Effect on their Nutritional Value. London, July 1942.

Food Supplies in Relation to Human Needs. Part 3. Signs and Symptoms of Deficiency Diseases. Auchterarder, August 1942.

Trace Elements in Relation to Health. London, October 1942.

The Influence of Diet on Pregnancy and Lactation in the Mother, the Growth and Viability of the Foetus, and Post-natal Development. Part 1. Pregnancy. Edinburgh, December 1942.

The proceedings are published by The Nutrition Society, and are printed and distributed for them by W. Heffer & Sons Ltd., Cambridge, England. The subscription is now 25s. net per volume or 15s. net per double number. Orders may be placed with the Distributors or with any Bookseller.

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

HARRISON MEMORIAL PRIZE, 1944

In accordance with the Trust Deed governing the Harrison Memorial Fund, the Selection Committee consisting of the Presidents of the Chemical Society, the Royal Institute of Chemistry, the Society of Chemical Industry, and the Pharmaceutical Society, will proceed to make an award of the Harrison Memorial Prize in December, 1944, subject to the condition that the Selection Committee shall be of opinion that there is a candidate of sufficient distinction to warrant an award of the Prize.

The Prize, not exceeding £150, will be awarded to the chemist of either sex, being a natural born British subject and not at the time over thirty years of age, who, in the opinion of the Selection Committee, shall, during the previous five years, have conducted the most meritorious and promising original investigations in Chemistry and published the results of those investigations in a scientific periodical or periodicals.

Applications, five copies of which must be submitted, should contain the following information:

(a) Name (in full).
(b) Age (Birth Certificate must accompany application).
(c) Degrees (name of University where obtained).
(d) Other qualifications.
(e) Experience.
(f) Titles of published papers, with authors' names, including full references to publication.
(g) Where research was carried out.
(h) Testimonials and references.
(i) Any other particulars bearing on the application.

The Selection Committee is prepared to consider applications, nominations, or information as to candidates eligible for the Prize. Any such communication must be received by: the President, The Chemical Society, Burlington House, Piccadilly, W.1, not later than Friday, Dec. 1, 1944. Candidates must not be more than 30 years of age at this date.

LONDON (ROYAL FREE HOSPITAL) SCHOOL OF MEDICINE FOR WOMEN

(UNIVERSITY OF LONDON)

Hunter Street, Brunswick Square, W.C.1

Entrance Examination, 1945

Notice is hereby given that an Entrance Examination for all candidates for admission to the 1st and 2nd Medical Courses in October, 1945, will be held on January 25, 1945.

Applications on the prescribed form must be received by January 1, 1945.—Full particulars and application forms may be obtained from the undersigned.

NANCIE MOLLER,
Warden and Secretary.

BELFAST EDUCATION COMMITTEE

COLLEGE OF TECHNOLOGY

Applications are invited for the position of Assistant Lecturer in the Mechanical Engineering Department. Candidates must possess an approved University Degree or its equivalent and should preferably be qualified to teach Metallography and Heat Treatment.

The salary is on Group D of the Ministry of Education for Northern Ireland scales—£250 by annual increments of £10 to £300 and thereafter by £15 to £450. Appropriate war bonus is paid. The maximum salary will be increased by £50 to holders of honours degrees. Past service in Great Britain is recognized for pension and increment purposes.

Application forms and full particulars may be obtained from the undersigned, with whom the forms must be lodged not later than Monday, Oct. 30, 1944.

J. STUART HAWNT,
Director of Education.

Education Office,
College of Technology, Belfast.

THE POLYTECHNIC

REGENT STREET, LONDON, W.1

DEPARTMENT OF CHEMISTRY AND BIOLOGY

A full-time LECTURER IN CHEMISTRY is required in January, 1945.

The work will include advanced Physical Chemistry up to B.Sc. special standard.

Salary in accordance with the Burnham Technical Scale for London (plus wartime bonus), subject to the usual 5 per cent. deduction for superannuation.

Forms of application, which must be returned by Oct. 16, can be obtained by sending a stamped addressed foolscap envelope to the Director of Education, The Polytechnic, 309 Regent Street, W.1.

STAFFORDSHIRE EDUCATION COMMITTEE

COUNTY TECHNICAL COLLEGE, WEDNESBURY

Applications are invited for a Lectureship in the Engineering Department of the College. An Engineering Degree and ability to teach Mathematics up to Higher National Certificate standard are essential. Teaching and Industrial experience are desirable.

Salary will be in accordance with the Burnham Technical scale plus war bonus, but the payment of an additional allowance to a man with suitable qualifications will be considered. Form of application and conditions of appointment may be obtained from the undersigned by whom applications should be received on or before Saturday, October 14, 1944.

F. A. HUGHES,
Director of Education.

County Education Offices,
Stafford.

CITY OF LEICESTER EDUCATION COMMITTEE

COLLEGE OF TECHNOLOGY AND COMMERCE

Principal:
L. W. Kershaw, O.B.E., B.Sc., A.M.I.C.E.

Required, a full-time Lecturer in Chemistry. Applicants should possess an Honours Degree and be able to teach the subject to Degree standard; experience in industry would be of advantage.

Salary in accordance with the Burnham (Technical) Scale, with allowance for industrial experience (plus war bonus).

Applications, together with copies of not more than three recent testimonials, and names of two persons to whom reference may be made, should be sent to the Principal, College of Technology and Commerce, The Newarke, Leicester, not later than Oct. 18, 1944.

H. S. MAGNAY,
Director of Education.

THE UNIVERSITY OF MANCHESTER

BEYER CHAIR OF ENGINEERING

Applications are invited for appointment to the above post in Faculty of Science. Stipend £1,300 to £1,600 per annum, according to qualifications. It is hoped that the successful candidate would enter upon his duties on Sept. 29, 1945, but arrangements might be made to commence at a later date. Candidate should possess qualifications in Civil or Mechanical Engineering or both.

Applications, which must be received on or before Nov. 18, 1944, should be sent to the Registrar, The University, Manchester, 13, from whom further information may be obtained.

THE UNIVERSITY OF LIVERPOOL

The Council of the University of Liverpool invites applications for the David Jardine Chair of Electrical Engineering (with special reference to Electronics and the relations between Electrical Engineering and Physics). Salary not less than £1,500 per annum. The University is prepared to grant leave of absence on the ground of work of national importance to a professor who is unable to take up his duties upon appointment. The last date for the receipt of applications is Dec. 29, 1944. Candidates who are overseas may apply by cablegram, giving the names of three referees.—Further particulars can be obtained from the undersigned.

STANLEY DUMBELL,
Registrar.

KING'S COLLEGE, NEWCASTLE UPON TYNE

IN THE UNIVERSITY OF DURHAM

Applications are invited for the post of Research Assistant in the Veterinary Laboratory of the Agricultural Department of King's College. Salary from £300 to £500 per annum, according to qualifications and experience.

Further particulars may be obtained from the undersigned to whom four copies of applications, together with the names of three persons to whom reference may be made, should be sent not later than Saturday, Oct. 14, 1944.

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

RESEARCH FOR THE PAPER AND BOARD INDUSTRY

The British Paper and Board Research Association in process of formation propose, at an early date or when National Service obligations permit, to appoint a Director of Research at a salary of the order of £2,000 per annum with participation in the Federated Superannuation System for Universities. Interested research workers of British nationality (by birth) are invited to forward to the President of the Paper Makers' Association of Great Britain and Ireland, Melbourne House, Aldwych, London, W.C.2, such particulars of their career as will indicate (a) their attainments in Science and/or Engineering, and (b) an ability to organize a research station and to lead a large research staff.

Applications are invited for appointments as Assistants at the Fuel Research Station, Blackwall Lane, Greenwich, London, S.E.10, for abstracting and translating of scientific literature relating to fuels. Candidates should have qualifications in one or more of the following subjects: Chemistry, Physics, Engineering; together with a good knowledge of French and German. A working acquaintance of either Russian or Spanish would be an advantage. Salary in the range of £250—£500 per annum (inclusive of war bonus), according to qualifications and experience.—Applicants should write, quoting F.2985A, to the Ministry of Labour and National Service, Central Register, Room 432, Alexandra House, Kingsway, London, W.C.2, for the necessary forms, which should be returned completed on or before Oct. 21, 1944.

Applications are invited for the position of Deputy to the Chief Chemist and Metallurgist of a Works in North-West England. Candidates must possess a good knowledge of organic chemistry and metallurgy as applied to the materials used for the distribution of electricity, and be experienced in administration. Salary, £800 to £1,000 per annum. Submit full details with application.—Reply to Box 253, T. G. Scott & Son, Ltd., 9 Arundel Street, W.C.2.

Experienced Organic Microanalyst, familiar with the standard determinations, urgently required in the Organic Chemistry Department, Imperial College, London, S.W.7. Salary according to age and experience, superannuation scheme in operation.—Detailed applications, with recent testimonials, must be received by the Professor of Organic Chemistry before Oct. 21, 1944.

B.Sc. (30) Chemistry, Physiology, Zoology, wants Biological post, now or at end of war. Experienced microscopist. Now on research and experimental work in dyestuffs.—Box 252, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Microcopying. — Typescripts, Rare Books, Scarce References Copied. 2d. per page (minimum 3s. 6d.). Send by registered post to: Adrian Cotes, 68 Carlton Hill, N.W.8.

Wanted: Complete sets and runs of Scientific Periodicals, including NATURE and Learned Society publications.—The Scientific Book Supply Service, 5 Fetter Lane, London, E.C.4.

Microscopes, of all descriptions, only a few available second-hand, perfect condition. Send details of your requirements enclosing 3d. stamp. — Telephone or correspondence only: Chards, 47 Beckenham Road, West Wickham, Kent (Spring Park 1628).

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collections. At the wish of the Prince of Wales, a special invitation to take part in the International Fisheries Exhibition of 1883 had been sent to the Chinese Government, which responded by instructing the Inspectorate-General of Maritime Customs to make the necessary arrangements. The resultant Chinese Court in the Exhibition at South Kensington was a great success, and it continued with additions to do service at two other International Exhibitions, Health and Inventions, held in 1884 and 1885 respectively.

The catalogue of the Chinese part at the Health Exhibition shows that the intention was, like that of Mr. Dunn, to represent the material civilization of everyday China. There were typical living-rooms fully furnished, lay figures dressed in costumes worn by every class, various means of transport including a catafalque, stoves, weapons and a macabre item in an effigy of a dead Buddhist priest undergoing cremation. Thirty Chinese came from China: ten shopkeepers to ply their trade in four well-stocked shops; ten cooks to supply Chinese dishes in the restaurant; six musicians to sing, play and act; a carpenter, a painter and two barbers to exercise their callings in public. As to the shops, the carved fronts for which came from China, one was occupied by a Peking firm of curio dealers, one by a firm from Kiukiang with modern porcelain, one by tobacconists from Hankow, and one by a Canton firm selling miscellaneous fancy goods.

These exhibitions marked a new phase. Since the sixteenth century, when free intercourse by sea began between the Far East and the West, products of Chinese craftsmanship had been imported in profusion. Few houses of the well-to-do in Britain lacked some example, and the strange charm of these things inclined our forefathers to accept unhesitatingly fanciful and Utopian accounts of their place of origin. Indiscriminate admiration for Chinese notions and products, and those supposedly Chinese, was the vogue. Towards the latter part of the eighteenth century fashion changed and intellectual Europe became obsessed with the world of ancient Greece and Rome. In the nineteenth century commerce and other contacts increased our opportunities of knowing the real China, and then we started to explore the field of art and archæology in earnest. The notable collection of Mr. A. W. Franks (afterwards Sir Wollaston Franks), first exhibited in 1876, passed in time to the British Museum and provided the foundation of Chinese ceramic collections there. The exhibition in 1876 was ably described by Mr. Franks in a remarkable catalogue which shows a true scientific spirit. But the greatest advance in such studies was achieved by the numerous writings of Dr. S. W. Bushell, who had the advantage of contact with Chinese scholars while serving as medical officer to the British Legation in Peking during 1868–1899. He it was in 1882 who made a basic contribution to the Victoria and Albert Museum by undertaking to buy for it a number of objects of Chinese craftsmanship, chiefly porcelain. For the same Museum he wrote two volumes of a handbook on "Chinese Art", published in 1904 and 1906, which as to scope and scholarship was a pioneer work and has not yet been bettered in some respects. Another medical man did a like service as to Chinese painting. William Anderson, who had been professor of anatomy and surgery at a college in Tokyo, sold his collection of paintings to the British Museum in 1882. Of these, 114 were Chinese, and they formed a nucleus. Four years later was published his catalogue of Chinese and Japanese paintings in the Museum, the first serious study of the subject in a Western language—again an instance of British initiative.

Such were the signs during the middle nineteenth century of reawakened interest in the material culture of China. In both our great national museums progress was quickened by bequests and the example of private collectors. For example, George Salting allowed for more than twenty years his unrivalled collection of some two thousand pieces of Ch'ing porcelain to be displayed in the Victoria and Albert Museum, and bequeathed it to remain there after his death, which occurred in 1910. Our greatest collector was George Eumorfopoulos. During the first thirty-five years of this century he gathered together with rare enterprise and acumen more than four thousand objects representative of nearly all media of Chinese art and craftsmanship. His collection set a new standard; it was bought for the nation in 1935 and then divided between the British and the Victoria and Albert Museums.

Mention has not yet been made of bronzes, because they scarcely figured at all in the early days. Probably Eumorfopoulos was the first to recognize the significance of ritual bronzes as the chief monuments of ancient Chinese civilization and basic criteria for the beginnings of Chinese art. Even Bushell seems to have been unacquainted with the best archaic bronzes, if one may judge from his writings. Though Eumorfopoulos gradually added many to his collection, no truly representative lot of bronzes had been seen in Great Britain until the great International Exhibition of Chinese Art in London, which during less than four months in 1935–36 attracted nearly half a million visitors. Many considered the bronzes the most illuminating exhibit because of the carefully chosen series of 108 pieces lent by the Chinese Government. Undoubtedly this display, so essential to an understanding of early Chinese culture, created a deep impression and stirred collectors to fresh effort. Quite a number now own notable bronzes: for example, Sir Alan Barlow, Mr. Robert Bruce, Mr. A. E. K. Cull, Sir Herbert Ingram, Sir Neill Malcolm, Mr. H. Oppenheim and Mr. and Mrs. Walter Sedgwick. The Cull Collection, small yet important, may be studied in a published catalogue.

From the first the ceramics have been better represented than any other medium. An attempt at a statistical survey would be wearisome; suffice it to say that almost all museums in Britain have some specimens, but comprehensiveness is approached in none except the British and the Victoria and Albert. The Lady Lever Art Gallery at Port Sunlight has a magnificent range of Ch'ing porcelain and little from other periods. That reflects the prevailing aim of collectors in the last century, who were content with these superb later products. During recent decades the fashion has been to seek the wares of earlier periods, and some remarkable collections are the outcome. Those of Sir Alan Barlow, Mr. and Mrs. Alfred Clark, Sir Percival David and Sir Herbert Ingram should be mentioned. The Clark Collection may be studied from photographs at the Courtauld Institute of Art, and an account of the David Collection has been published. The Ingram Collection is specially strong in Yüeh ware.

In a short article omissions are inevitable. Yet jade must not be left out, since it has always figured prominently in the social and religious life of China. That ardent connoisseur, the late Oscar Raphael,

had a special liking for jade. His fine collection of Chinese antiquities in jade and other media was bequeathed to the British and Fitzwilliam Museums. Numerous jade carvings are among Sir Charles Hardinge's collection of 2,539 small objects made of more than a hundred different materials, the whole affording striking evidence as to Chinese beliefs, customs and handicrafts. Also of ethnological value is the Chinese section in the Wellcome Historical Medical Museum. It contains, besides drugs and acupuncture instruments, very diverse exhibits, including many amulets. The student will find special satisfaction in the Cambridge University Museum of Archæology and Ethnology, because here are weapons, tools, currency and pottery from the earliest times, all arranged in chronological sequence. Finally, a word is due concerning the inscribed bone and tortoise-shell fragments found near An-yang at the end of last century. They put back the limits of authentic history and tell us of Chinese civilization more than three thousand years ago. In all, some 2,820 of these fragments belong to three collections: in the Royal Scottish and British Museums and in the ownership of Mr. L. C. Hopkins, *doyen* of the few Western students of archaic Chinese script.

To sum up: there are public and private collections in Britain rich in objects with æsthetic appeal, but poor in those not classed as 'art' which throw equal light on the history of Chinese civilization. Except in the aforesaid Cambridge Museum, small effort seems to have been made to trace evolutionary sequence in the ordinary things of life. Our collections are much scattered and duplicated; we need a central Chinese Museum.

NEWS and VIEWS

Visit of Indian Men of Science

IT is now expected that the distinguished Indian scientific men who will shortly visit Great Britain will arrive about the second week of October. They expect to stay in England for about seven weeks, during which time they will visit important scientific laboratories and industrial, medical and agricultural research institutions in and near London in the Midlands and north of England and elsewhere in the United Kingdom; they will also discuss modern scientific progress with such bodies as the Royal Society, the Department of Scientific and Industrial Research, the Medical Research Council, the Agricultural Research Council and the Radio Board. This visit is a sequel to the visit to India last winter of Prof. A. V. Hill, secretary of the Royal Society. It was then suggested that Indian scientific men should be given an opportunity of coming to the United Kingdom and of establishing closer relations between the many new scientific organizations in India and corresponding organizations here. The proposal was warmly welcomed by H.M. Government and by the Government of India. They will be the guests of His Majesty's Government while they are in Great Britain.

The party will probably consist of the following: Dr. Nazir Ahmad, director of the Cotton Technological Laboratory, Matunga, Bombay; Colonel S. L. Bhatia, deputy director-general of the Indian Medical Service; Sir Shanti S. Bhatnagar, director of scientific and industrial research, India; Sir Jnan Chandra Ghosh, director of the Indian Institute of Science, Bangalore, and president of the National Institute of Sciences of India; Prof. S. K. Mitra, of the University College of Science, Calcutta, chairman of the Radio Committee of the Board of Scientific and Industrial Research; Prof. J. N. Mukherjee, professor of chemistry, University of Calcutta; Prof. Megh Nad Saha, of the University College of Science, Calcutta. Colonel Bhatia's departure from India is expected to be delayed, and he will not join the party until later.

Professorship of Concrete Technology at the Imperial College, London

A RECENT benefaction from the Cement Makers' Federation has enabled the Imperial College, with the approval of the University of London, to institute in its City and Guilds College a new chair of concrete technology. It may not be possible to appoint a professor until after the termination of war with Germany. The chair will be instituted in the first instance for ten years, and will be attached to the existing Department of Civil Engineering. The duties of the professor will be to provide advanced instruction in the principles and technological application of reinforced concrete, to conduct research in his subject, and to consult with industry regarding the practical experience which it will give to students in training. In order to establish the necessary contact with industry, an advisory committee is contemplated, with appropriate representation of interested bodies, which will report to the governing body of the College. At the end of the ten-year period it will review the working of the scheme and advise as to its continuation or termination. A noteworthy feature of the scheme, which might well be followed as a model in future planning of training for technology, is an arrangement, sponsored by a number of building and civil engineering contractors, whereby bursaries will be made available to students devoting one or two years (after a preliminary study of the basic sciences) to intensive study of concrete technology. It has been agreed that industry looks for graduates broadly trained in the fundamental sciences, but with specialized knowledge superimposed; and that its willingness to provide such bursaries is the best assurance that can be given of its intention to absorb men who have thus committed themselves to a specialized course of training.

Prof. Frank Allen

Prof. Frank Allen has just retired from the position of head of the Department of Physics, of the University of Manitoba, Winnipeg, Canada, after forty years of service. He is a native of Canterbury, New Brunswick, born on February 6, 1874, and is thus one of the great army of educationists given by the Maritime Provinces of Canada to the West. After graduation from the provincial University of New Brunswick in 1900, he spent four years at Cornell, at a time when the United States physicists were just beginning to realize the importance of their calling. Allen received his Ph.D. degree at Cornell and in the autumn of 1904 entered on his work in Manitoba. He has made an important contribution to physics in Canada. He was elected a fellow of the Royal Society of Canada in 1909 and served as a member of the National

Research Council of Canada from May 1932 until March 1937.

Of his work at Manitoba, Mr. Sidney Smith, who has just retired from the post of president of the University of Manitoba, says: "Dr. Frank Allen was a pioneer and a builder in the first university in Western Canada—the University of Manitoba. Appointed to the staff of that University in 1904, when it became a teaching institution, he founded the Department of Physics, of which for forty years he has been the distinguished head. As a gifted teacher, his record may be read in the careers of generations of students. To the new university he brought an inquiring mind and the spirit of research. He constantly advocated that a university is charged with the responsibility of conserving and transmitting the wisdom and culture of the past and also with the duty of extending the horizons of knowledge. He always considered physics in relation to the other physical sciences and, in fact, as a part of a truly liberal education. Specialization did not narrow his outlook: it broadened his interests and influence".

Prof. Allen's research work has been almost entirely on the rather dim borderland where physics, physiology and psychology, the 'three p's', meet. His first work was on colour vision. His aim was to investigate the nervous actions underlying colour vision and other sensory activities. In his own words, the aim of his work was first to place the sense of colour vision on a foundation of experimentally ascertained physiological principles, and then to establish the fundamental identity of the processes underlying all of the special senses, including vision, hearing, taste and touch. Prof. Allen is now engaged on collecting the results of his life-work; many of his papers have appeared in scientific journals, particularly the *Transactions of the Royal Society of Canada*. Prof. Allen's wife died some years ago, but he has a family of two sons and one daughter—Dr. J. F. Allen, who has just been elected to a fellowship at St. John's College, Cambridge; William Allen, an architect in London (England); and Miss Lillian Allen, on the staff of the University of Manitoba. Prof. Allen's many friends join in wishing him many happy years of useful work.

Chair of Psychology, Birkbeck College

DR. C. A. MACE, who has been appointed to the chair of psychology at Birkbeck College, University of London, holds the degrees of M.A. Cambridge and D.Litt. London. After leaving Cambridge he was for a time at University College, Nottingham. From there he was appointed lecturer in logic and psychology in the University of St. Andrews. He left Scotland to take up the position of University reader in psychology at Bedford College, London. Dr. Mace has published books and papers in both psychology and philosophy, his best-known work in philosophy being the "Principles of Logic" (1933). In psychology his interests are mainly in social and industrial spheres, and in problems concerning economical methods in learning. In 1935 he published a monograph "Incentives, some Experimental Studies" (Ind. Health Res. Bd. Report No. 72). This was mainly concerned with problems arising in industry owing to variations in the will to work of the employee in contrast to the more usual studies of ability. Dr. Mace has also worked on the fluctuations of interests of college and Workers' Educational Association students over several years, and on the psychological make-up of groups of friends. His latest publication is a paper in the *Sociological Review* on some of the psychological causes of national prejudice. In this paper he makes an important theoretical distinction between stereotypes, or rigid mechanisms of thought, and plastotypes, or more fluid ones. Dr. Mace has always been keenly interested in adult education, so his appointment to Birkbeck College seems a singularly happy choice.

Book Production

IN connexion with the recent discussion of the shortage of educational and other books (see *Nature*, September 9, p. 319), the following reply given by Mr. Dalton in the House of Commons on September 26 should be noted: "The Minister of Production has agreed, at my request, to increase the allocation of paper to publishers of books as from the end of next month to 42½ per cent of their pre-war usage. I hope that the publishers will do all they can to devote this extra paper to supplying liberated territories, as well as Empire and other oversea markets. The Minister of Production has also increased by more than one third the allocation to my special reserve, and has made a further additional allocation for certain classes of educational books. I am in touch with the Minister of Labour about the supply of labour for printing and binding." The additional allowance of 2½ per cent of publishers' 1938–39 consumption of paper will be welcome; but it is difficult to see how Mr. Dalton's hope that the extra paper should be used to supply liberated territories and overseas markets could be fulfilled. It seems very doubtful if any publisher would be able to differentiate sharply between books for such overseas markets and those for use in Great Britain. In any event, there is a definite shortage of educational and scientific books, which are needed as much at home as abroad. Publishers are well aware of this, and will no doubt do all in their power to overcome it. They will also note Mr. Dalton's remark that he is in touch with the Minister of Labour about the supply of labour in the printing and binding trades. As we have said before, these trades have been stripped of labour, and until more workpeople are made available, full use cannot be made of the additional allocation of paper for the production of educational and other books.

Practical Limits in Social Reform

BULLETIN No. 5 of the Tory Reform Committee "What Shall We Use for Money?" is of interest as an attempt to indicate the broad limits of what is politically and economically practicable in the field of social reform. The pamphlet distinguishes between income and outlay of the nation as a whole, and the Exchequer aspect, or that part of the national income which passes through the Revenue and Expenditure of the Exchequer. These aspects are discussed separately, and a survey of post-war national outlay and national income after the War emphasizes that our standard of living will, and always must be, dependent on the maintenance of high productive efficiency. Discussing, in conclusion, finance and politics, the Tory Reform Committee does not believe that the measures of social reform which it has championed are beyond the taxable or economic capacity of the nation to bear, or beyond the willingness of the majority of individuals to provide by personal effort and sacrifice. It is well aware, however, that such

limits exist, and they have for the time being been nearly approached; the Committee urges that the time has come to concentrate upon increasing the national income in the cause of social progress by every means and particularly by increased industrial efficiency. The pamphlet is an honest attempt at clear thinking and is a striking contrast to recent pronouncements regarding the adoption of a forty-hour week, which have omitted all indication of the price which has to be paid for adopting any such objective in our immediate post-war programme.

Geographical Research in China

AN account of geographic research in China by Prof. Chi-Yun Chang (*Ann. Assoc. Amer. Geog.*, **39**, No. 1, March 1944) contains a record of a great deal of valuable work, much of which, under present conditions, may have escaped notice in Great Britain. Large numbers of topographical maps have been printed recently including a bathyorographical one of the whole of China on a scale of one to three million. A beginning of land utilization maps has been made, and a generalized soil map has been published. The Research Institute of Meteorology of the Chinese Academy has been investigating the problems of winds and rainfall over China with the result that the old conception of the south-east monsoon being chiefly responsible for the rainfall has been displaced in favour of cyclonic influences being mainly responsible: most of the rainfall appears to be associated with cold fronts. In historical and other aspects of human geography research has also been active. The report also notes the development of geographical education, probably temporarily interrupted, the foundation of the Chinese Institute of Geography and a number of geographical periodicals.

Russian Papers on Pure and Applied Mathematics

A NUMBER of Russian publications containing papers on pure and applied mathematics have been received, and most of them have at least an abstract in English, French, or German. In a few cases the papers are entirely in English. They include numbers of the *Bulletin of the U.S.S.R. Academy of Sciences* (*Mathematical Series*) (1941–43), the Moscow *Receuil Mathématique* (1942–3), *Applied Mathematics and Mechanics* (1943), *Engineering Review* (1943), and *Comptes Rendus* (1943). It is difficult to describe the mathematical contributions in a limited space; they deal with trigonometrical series, the theory of functions and other topics such as are treated in our own mathematical journals. As regards the engineering papers, attention may be directed particularly to the papers by Glagolev, Popov and Proktor on "The Mechanical Properties of Rubber"; Erokhin, Nikolaeva and Oghibalov on "Dynamic Brittleness of Metals"; Kasparov on "Distribution of Pressure on the Blades of a Hydroturbine" (all in *Eng. Rev.*, **2**; 1943) and to those by Astrov, Levin, Pavlov, and Khristianovitch on "The Design of the Laval Nozzles", Pugachev on "The General Problem of Exterior Ballistics for Aviation Bombs", Četajev on "The Sufficient Conditions of the Stability of a Rotating Motion of a Projectile", Banin on "Approximate Conformal Transformations applied to the Plane-Parallel Flow past an Arbitrary Shape" (all in *App. Math. and Mech.*, **7**; 1943).

Identification of Timbers

MR. ALEXANDER L. HOWARD'S "Studies of the Identification of Timbers" was reviewed in *Nature* of November 7, 1942. It is interesting now to record the appearance of a supplement containing 153 photomicrographs of different kinds of wood ("Supplement to Studies of the Identification of Timbers." By Alexander L. Howard. Pp. 19. London: Macmillan and Co., Ltd., 1943. 5*s*. net), and one cannot but admire the author's continued enterprise in producing a supplement to a book of this kind in time of war, and promising yet another in the near future. Attention was directed, when reviewing the original volume, to certain features of the book which limit its practical value. Since the supplement has been prepared along precisely the same lines, it will be found to present similar difficulties when used for the practical identification of timbers.

Announcements

WE regret to announce the death of Sir John Ledingham, C.M.G., F.R.S., formerly director of the Lister Institute, London, on October 4, aged sixty-nine.

THE Council of the Royal Aeronautical Society has awarded the Society's Gold Medal to Air Commodore Frank Whittle, for his work on jet propulsion. This award is the highest the Council can make, and has been made on only seven previous occasions, the recipients being as follows: Wright Brothers (1909), Prof. O. Chanute (1910), Prof. G. H. Bryan and Mr. E. T. Busk (1915), Dr. F. W. Lanchester (1926), Prof. L. Prandtl (1927), Sir Richard Glazebrook (1933) and Senor Juan de la Cierva (posthumously, 1937).

THE following appointments have been made in the University of London: Mr. H. Berry, to be professor of pharmaceutics; Dr. W. H. Linnell, to be professor of pharmaceutical chemistry. Both appointments are tenable at the College of the Pharmaceutical Society.

THE National Council for Mental Health has arranged a course of ten lectures, by various authorities, on "The Psychology of Frustration and Fulfilment in Adult Life". The lectures, which are addressed specially to those with social and educational interests, are being given on Tuesdays at 5.30 p.m. at the Caxton Hall, London, S.W.1, and began on October 3. A parallel course is being given on Wednesdays at 5.30 p.m. at the Friends' Meeting House, Bull Street, Birmingham. Tickets for the course can be obtained, price £1, from the Secretary, National Council for Mental Hygiene, 39 Queen Anne Street, London, W.1, or single tickets, 3*s*. 6*d*., at the door before each lecture.

THE Selection Committee of the Harrison Memorial Fund, consisting of the presidents of the Chemical Society, the Royal Institute of Chemistry, the Society of Chemical Industry and the Pharmaceutical Society, will make an award of the Harrison Memorial Prize in December 1944. The Prize, not exceeding £150, is open to a chemist of either sex, being a natural born British subject and not at the time more than thirty years of age, for original investigations in chemistry carried out and published during the past five years. Further particulars can be obtained from the President, Chemical Society, Burlington House, Piccadilly, W.1. Applications must be received not later than December 1, 1944.

LETTERS TO THE EDITORS

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

Extraction and Purification of Penicillin

PUBLISHED methods for the extraction and purification of penicillin[1,2,3] are all based on the observation that penicillin can be extracted by ether, amyl acetate or chloroform from strongly acid aqueous solutions. Considerable losses of the antibacterial substance occur during these operations as penicillin is very rapidly destroyed in acid environment, particularly when shaken with air at room temperature.

A search was made for solvents which would extract penicillin from aqueous solutions at a *p*H not harmful to penicillin. It has been found that a large proportion of the antibacterial substance can be extracted by *n*-butyl alcohol from culture filtrates adjusted to *p*H 6·4, at which penicillin is most stable. When a suitable amount of ammonium sulphate was added to the culture filtrate, penicillin was then almost completely extracted by the butyl alcohol. The addition of ammonium sulphate was also of advantage as it precipitated the greater part of the inactive pigments. Penicillin was brought back into aqueous solution by the addition to the butyl alcohol extract of light petroleum ether and dilute sodium bicarbonate solution. During this procedure further purification of penicillin was effected as some impurities remained in the petroleum ether. The concentrated penicillin solution may be further purified by the usual method (ether extraction).

A typical experiment was as follows: 2,000 ml. of the crude culture fluid was adjusted with phosphoric acid to *p*H 6·4 and 800 gm. of ammonium sulphate was dissolved in it. A precipitate containing inactive proteins and pigments formed and was filtered off. 400 ml. of the filtrate was mixed with an equal volume of *n*-butyl alcohol and extracted by shaking. The same butyl alcohol extract was used for the subsequent extraction of four further 400 ml. portions of the culture fluid. To the strong butyl alcohol extract, 400 ml. in bulk, an equal volume of light petroleum ether was added. From this mixture penicillin was extracted by shaking into 200 ml. of a 2 per cent aqueous solution of sodium bicarbonate. The greater part of penicillin contained in the culture fluid was obtained in this way as an aqueous solution of the sodium salt of penicillin. The remaining penicillin was obtained by a second extraction of the butyl alcohol–petroleum ether mixture with another portion of the sodium bicarbonate solution.

The principal advantages of this method of extraction are: (1) there is no loss of penicillin during extraction as it is extracted at the *p*H point of its greatest stability; (2) the antibacterial substance is almost completely extracted from the culture fluid; and (3) considerable concentration and purification is achieved by the same process. Further advantages of the method are that extraction can be carried out at room temperature and that only relatively small quantities of solvents are required. The procedure is simpler and more efficient than other methods of purification and appears suitable for large-scale purification of penicillin.

I am much indebted to Prof. P. L. Sutherland for his advice and interest throughout the course of this investigation. My thanks are due to Mr. G. Denton for technical assistance.

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Thiophanone Derivatives

FOLLOWING the recent papers of P. Karrer *et al.*[1,2,3,4] and the communications of E. R. Buchman and H. Cohen[5], R. B. Woodward and R. H. Eastman[6] and L. C. Cheney and J. R. Piening[7] on the synthesis of thiophanone derivatives, it seems desirable to direct attention to work carried out independently in this laboratory on the same subject.

Our method of preparing thiophanones is substantially the same as that of the above authors, and we have described it in the patent literature[8,9,10]. However, in our experiments on the ring closure of ethyl S-(β-carbethoxyethyl)-thioglycollate under the influence of powdered sodium in benzene, we found that ethyl thiophan-3-one-*2*-carboxylate always at least predominates, whereas Karrer *et al.*[1] and Buchman and Cohen[5] report the formation of the *4*-carboxylate. Our evidence for this assertion is based on the following products obtained from the Dieckmann reaction on: (i) ethyl S-(β-carbethoxyethyl)-thioglycollate, giving a cyclic keto-ester which yielded a crystalline derivative with urea[11], m.pt. 173°; (ii) methyl S-(β-carbethoxyethyl)-thioglycollate, giving a product, with urea derivative, m.pt. 222°; (iii) ethyl S-(β-carbmethoxyethyl)-thioglycollate, giving a product, with urea derivative, m.pt. 173° (admixture with that from (i) showed no depression); and finally (iv) methyl S-(β-carbmethoxyethyl)-thioglycollate, the urea derivative of the product of which melted at 222° and did not depress the melting point of that from (ii) on mixing.

That mixtures do occur was shown by subjecting *n*-butyl S-(β-carbmethoxyethyl)-thioglycollate to the same conditions (namely, powdered sodium in benzene), when *two* products were obtained. The main fraction was *n*-butyl thiophan-3-one-2-carboxylate (found: C, 52·7; H, 7·2; S, 15·6. $C_9H_{14}O_3S$ requires C, 53·4; H, 6·9; S, 15·8 per cent) and gave a derivative with urea, m.pt. 170–172° (found: C, 48·8; H, 6·3; N, 10·7. $C_{10}H_{16}O_3N_2S$ requires C, 49·2; H, 6·6; N, 11·4 per cent). The small low-boiling fraction gave a urea derivative, m.pt. 245°, the analysis of which showed it to be derived from methyl thiophan-3-one-4-carboxylate (found: N, 13·2. $C_7H_{10}O_3N_2S$ requires N, 13·9 per cent).

Although it was possible to introduce a side chain in the 2-position (as would be required to reproduce the β-biotin carbon skeleton) by condensation of the corresponding halogeno-compound with ethyl thiophan-3-one-2-carboxylate in the presence of sodium ethylate[10], nevertheless this method was soon replaced by the more satisfactory one of subjecting esters of the type $EtOOC.CH_2.CH_2.S.CHR.COOEt$ (in

which *R* is the desired substituent) to the action of powdered sodium in benzene solution. In this case, of course, a non-ambiguous formation of the 4-carboxylate occurs. The product was treated with water at 200°[12] to yield directly the required 2-substituted thiophan-3-one[9].

It is worth recording that we synthesized the α-halogeno pimelic acid[13] required for the preparation of thiophan-3-one-2-valeric acid, by converting ethyl hydrogen pimelate to the corresponding acid chloride, which was brominated to the α-bromo-acid halide, followed by alcohol treatment to yield ethyl α-bromopimelate. We believe this constitutes a simpler process than that of Karrer *et al.*[4] or of Cheney and Piening[7].

Fuller details of this work will be published elsewhere.

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Peroxidase Activity of the Thyroid

THE finding of Schachner *et al.*[1] that the *in vitro* formation of diiodotyrosine and thyroxine by thyroid slices, with radioactive iodine, ^{131}I, as indicator, is inhibited by cyanide, azide, sulphide and carbon monoxide (particularly in the dark) led to an investigation of the occurrence of oxidases in the thyroid. The production of a strong peroxidase reaction and the recent publication of a paper by Dempsey[2] focused attention on this enzyme. Dempsey, using the benzidine histological technique, reported the presence of peroxidase in the follicular cells of the thyroid. He claims that the peroxidase reaction is not due to hæmoglobin, since it was discrete and there was no continuity between erythrocytes and intracellular reacting granules. The cellular peroxidase reaction was found to be inhibited by thiouracil and in much smaller concentration than was necessary to inhibit the hæmoglobin reaction. Owing to the non-specificity of the benzidine reaction and the fact that the high concentration of hydrogen peroxide employed in the histological technique would effectively inhibit true peroxidase, however, this finding requires more careful investigation, because of the obvious implications of the reported inhibition by thiouracil.

Since peroxidase catalyses the liberation of iodine from inorganic iodides by hydrogen peroxide, its presence in the thyroid would serve a useful function. Lipmann[3] found that peroxidase is inhibited by sulphonamides. This, however, is contrary to the finding of Keilin and Mann[4], but these latter workers found peroxidase to be partially inhibited by sodium fluoride, another goitrogenic agent. Westerfeld and Lowe[5] discuss the possibility that the quinol-ether linkage in thyroxine may be formed through a peroxidase condensation. They found a quinol-ether among the oxidation products of *p*-cresol by peroxidase. Keston[6] suggests that the xanthine oxidase system may play a part in biological iodinations, furnishing peroxide essential for peroxidase activity. Employing radioactive iodine, ^{131}I, and using milk as a source of xanthine oxidase, peroxidase and caseinogen, and adding xanthine as a substrate for the xanthine oxidase, he obtained significant iodination of the caseinogen. This reaction was inhibited by thiourea. Addition of catalase, however, did not affect the iodination.

The existence of peroxidase in animal tissues has been doubted. Bancroft and Elliott[7], however, consider that both spleen and lung probably contain true peroxidases, and Huszak[8] has made the interesting observation that the suprarenal medulla contains an active peroxidase but lacks a cytochrome oxidase system. The demonstration by Altchul, Abrams and Hogness[9] of a peroxidase, 'cytochrome *c* peroxidase', specific for cytochrome *c* suggests a wider distribution of peroxidase than is usually supposed and also a more important role for hydrogen peroxide in biological oxidations.

In the following experiments, horse thyroids were used, obtained very soon after death, each thyroid weighing approximately 10 gm. In the preliminary experiments, filtered aqueous extracts of very finely minced and ground tissue were used, the thyroid being extracted with five times its weight of water containing chloroform. Such extracts gave a strong peroxidase reaction (*p*-phenylene diamine, benzidine and pyrogallol as substrates) and a catalase reaction.

Peroxidase was determined by the purpurogallin method of Willstäter and Stoll[10] as modified by Elliott and Keilin[11]. This was inhibited to a certain extent by both thiourea and thiouracil as shown in Table 1. The catalase activity was not affected.

TABLE 1. INHIBITION OF HORSE THYROID 'PEROXIDASE' ACTIVITY BY THIOUREA AND THIOURACIL

Concentration of drug	Percentage inhibition produced by	
	Thiourea	Thiouracil
0·08 *M*	96	—
0·016 *M*	55	60
0·0016 *M*	5	5

An approximately 80 per cent reduction in peroxidase activity was produced by boiling the extract for five minutes.

In contrast to this order of inhibition produced by thiourea and thiouracil, milk peroxidase, prepared according to Elliott[12], was found to be inhibited to a much greater extent, as shown in Table 2.

TABLE 2. INHIBITION OF MILK PEROXIDASE ACTIVITY BY THIOUREA AND THIOURACIL

Concentration of drug	Percentage inhibition produced by	
	Thiourea	Thiouracil
0·01 *M*	92	95
0·001 *M*	70	91
0·0001 *M*	20	79
0·00001 *M*	0	30

This discrepancy in the effective inhibitory concentrations of thiourea and thiouracil in these two systems suggested that there might not be any true peroxidase in thyroid and that peroxidase activity could probably be accounted for entirely by hæmoglobin. The peroxidase activity of horse thyroid was in any event small, having an average purpurogallin number (calculated for the water-extractable enzyme) of 6×10^{-3}. Moreover, the peroxidase activity of dilute hæmoglobin solutions was found to be inhibited to approximately the same extent as the aqueous thyroid extracts by boiling and by thiourea and thiouracil.

The hæmoglobin content of a thyroid extract was determined by the benzidine method as described by Ashby and Chan[13], and of horse blood diluted to give a solution of the same hæmoglobin content. The peroxidase activity of both diluted blood and of the thyroid extract was determined. In the case of the thyroid extract, the catalase content was first determined by the method of Bancroft and Elliott[7] and extra hydrogen peroxide added so that the same optimal concentration of hydrogen peroxide was available for peroxidase activity for both diluted blood and thyroid extract. The purpurogallin formed was identical in both cases, showing that the peroxidase activity of the thyroid extract (purpurogallin number of $5{\cdot}8 \times 10^{-3}$) can be accounted for completely by its hæmoglobin content. It must be remembered, however, that in the above experiments an aqueous filtrate of thyroid was used. Bancroft and Elliott found that not all the peroxidase of animal tissues is extractable with water and used a glycerol suspension of the tissue for determining peroxidase activity.

To substantiate the above findings, the total peroxidase activity, using Bancroft and Elliott's glycerol extraction procedure, of horse thyroid, perfused with Ringer through the thyroid artery in an isolated neck preparation until almost blood free, was compared with that of the unperfused thyroid from the same horse. The total peroxidase activity was decreased considerably by perfusion, the perfused thyroid having an almost negligible activity, with a purpurogallin number of $1{\cdot}0 \times 10^{-4}$. The peroxidase activity of completely blood-free dog thyroids, pooled from twelve dogs previously bled from the heart, was also found to be small, with a purpurogallin number of $4{\cdot}1 \times 10^{-4}$.

It would appear from these results that the thyroid probably contains no true peroxidase, and that inhibition of the synthesis of thyroxine in the thyroid produced by various goitrogenic agents, including thiourea and thiouracil, cannot be accounted for by inhibition of peroxidase activity. For this reason it is doubtful whether xanthine oxidase participates in thyroxine formation. Moreover, horse thyroid was found to contain none of this enzyme. Bernheim and Bernheim[14] have shown that phenyl thiocarbamide inhibits tyrosinase activity. Using the purpurogallin method of Keilin and Mann[15], polyphenolase of potato was found to be inhibited to a considerable extent by thiourea, potassium thiocyanate and sodium fluoride, but aqueous thyroid extracts were found to contain none or negligible amounts of this enzyme.

Experiments are in progress on the effect of thiourea, thiouracil and other goitrogenic agents on the cytochrome oxidase system. Although Mann and Keilin[16] have shown that sulphonamides do not inhibit cytochrome oxidase activity, it is conceivable that the total concentration of cytochrome oxidase or cytochrome *c* in the thyroid might be diminished by sulphonamides or thiouracil.

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[16] Mann, T., and Keilin, D., *Nature*, **146**, 164 (1938).

Mepacrine Derivatives in Urine

IN collaboration with the Army Malaria Research Unit, we have developed a technique for the quantitative separation by chromatographic means of mepacrine from urine and from blood. The separation is effected on alumina and is made visible by the intense fluorescence emitted by acridine derivatives in ultraviolet light. In certain (but not all) specimens of urine from some groups of malarial patients receiving therapeutic courses of mepacrine we have observed that a yellow fluorescent band, not that of mepacrine, can be developed on the chromatogram. This band is not observed on chromatograms of normal urines from patients who have not been dosed with mepacrine. Further, a sample of urine to which an authentic specimen of pure 2-hydroxy-6-chloro-9-amino-acridine had been added gave a chromatogram exhibiting a yellow band identical with that obtained from the urines referred to above. The two bands, the one obtained from malarial urine and the other produced from a urine to which the amino-compound mentioned had been added, exhibited exactly similar behaviour on the alumina columns. Thus neither band could be eluted using methyl or ethyl alcohol, ether, benzene, chloroform, acetone, amyl alcohol, pyridine or even glacial acetic acid, whereas both bands were eluted by *N* hydrochloric acid.

A solution of the new acridine derivative was obtained by extruding the chromatogram developed from urine and extracting the band required with *N* hydrochloric acid. The solution showed the very characteristic change in fluorescent colour from yellow in acid solution to deep orange in alkali at *p*H 10·5, which is characteristic of 2-hydroxy-6-chloro-9-amino-acridine. On mixing the solution obtained from the extracted chromatogram with a solution of the authentic hydroxy-amino-compound, it was found impossible to separate the two components chromatographically.

We think it possible that the fraction *C* isolated from the urine of dogs dosed with mepacrine by Scudi and Jelinck[1], but not identified by them, may be the 2-hydroxy-6-chloro-9-amino-acridine mentioned above.

D. LL. HAMMICK.
D. FIRTH.

Dyson Perrin Laboratory,
Oxford. Aug. 10.

[1] *J. Biol. Chem.*, 152, 27 (1944).

Presence of a Labile Toxin in Yolk-Sac Cultures of Rickettsia

GIROUD[1] reported the presence of a specific toxic substance in suspensions of Rickettsia-infected organs which produced dermal lesions in rabbits. Gildenmeister and Haagen[2] found that yolk-sac cultures of Rickettsia are toxic for mice when injected intraperitoneally. We have been studying the nature of the toxin present in yolk-sac cultures of Rickettsia and summarize below some of the observations noted thus far.

Yolk-sacs of infected eggs were removed on the fourth day after inoculation, placed in buffered broth (one part nutrient broth and one part phosphate buffer *p*H 7·4), in the proportion of 1 part sac to 10 parts fluid and shaken in a mechanical shaker for 60 minutes. This process is sufficient to break up the infected cells, the rest of the sac membrane remaining intact, and yields a suspension relatively free from tissue cells and debris. The suspension is then decanted, centrifuged lightly to remove gross debris, and an opalescent fluid rich in Rickettsia obtained.

This suspension of Rickettsia when injected intradermally into rabbits gives on the second or, more usually, third day an indurated, inflamed nodule with a central necrotic area. If the suspension is centrifuged in an angle centrifuge at 4,500–5,000 revolutions for about two hours the supernatant fluid, now practically free of Rickettsia, still gives a typical skin reaction in rabbits even when diluted twenty to forty times. The injection of this supernatant fluid intraperitoneally into mice or rats is followed regularly, on the third to the fifth day, by a considerable enlargement of the spleen and liver without any Rickettsia being found even when murine strains are used. The sedimented Rickettsia resuspended in an equal volume of phosphate buffer (*p*H 7·4) and injected in the same manner give a similar but stronger reaction in rabbits, and in mice and rats Rickettsia can readily be seen in the enlarged spleen. This suspension of Rickettsia still produces a reaction in dilutions of 1 : 80, that is, it is two to four times as toxic as the supernatant fluid. If this suspension of Rickettsial organisms is frozen and thawed seven or eight times, the same reactions are obtained, although no live Rickettsia can be demonstrated either by yolk-sac cultures or by animal inoculations.

It appears, therefore, that the rabbit skin lesion and the splenic enlargement in mice and rats are caused by a toxic substance present in the supernatant fluid freed from Rickettsia, as well as in the organisms themselves. This toxin is present in cultures of both human (louse-borne) and murine (flea-borne) strains of Rickettsia.

This toxic substance, whether in the supernatant fluid or in the organisms, was found to be extremely labile. It was completely inactivated by heating for half an hour at 56–60° C., largely so at 50° C., but not at all at 40° C. The original culture suspensions diluted with an equal volume of distilled water, and kept at 37° C., lost their toxicity partly after two days and completely after three. A reduction in toxic strength occurred also after seven days in the ice box (10–12° C.).

Shaking with ether (Squibb U.S.P. for anæsthesia) for half an hour completely inactivated the toxin both in the supernatant fluid and in the Rickettsial suspension. After complete removal of the ether, no toxic effect resulted from injecting any of the fractions obtained by this treatment.

Rapid freezing and thawing of culture suspensions, seven or eight times, apparently killed the organisms, but the toxic strength of the supernatant fluid obtained after centrifugation in the angle centrifuge was enhanced. Similar treatment of the supernatant fluid, free of Rickettsia, resulted in a reduction of the toxicity. It appears that repeated freezing and thawing is to some extent injurious to the toxin, but that if the treatment is carried out when Rickettsia are present, the injury to the toxin is compensated by fresh toxin liberated from the organisms.

It seems, therefore, that the Rickettsial strains studied contain near the cell surface a toxic substance which is readily liberated into the medium in which they grow or are suspended. This toxin is highly labile, being destroyed at 56° C. in half an hour and at 37° C. in three days. From the point of view of vaccine preparation its inactivation by simple, rather brief, treatment with ether is of particular interest.

Our work has not yet proceeded far enough to indicate whether the toxins produced by the murine and human strains are antigenically distinct. Both produce the same reactions in rabbits, mice and rats, and both are equally labile.

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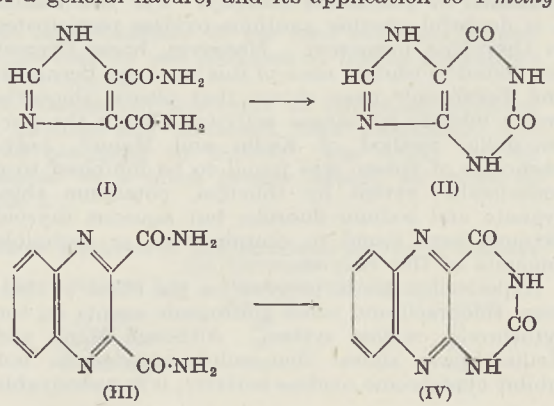
[1] Giroud, P., *C.R. Soc. Biol., Paris*, **127**, 864 (1938).
[2] Gildenmeister, E., and Haagen, E., *Deut. Med. Woch.*, **66**, 979 (1940).

A New Synthesis of Xanthine

BY the action of alkaline potassium hypobromite on phthalamide, Hoogewerff and van Dorp[1] obtained 2 : 4-dihydroxyquinazoline. Various applications of this intramolecular Hofmann reaction have since been reported; for example, when applied to succinamide, maleamide and pyrazine-2 : 3-dicarboxyamide, the reaction leads to dihydro-uracil[2], uracil[3] and lumazine[4] respectively. We have found that the reaction is applicable to *glyoxaline*-4 : 5-*dicarboxyamide* (I), which on treatment with alkaline hypobromite solution gives xanthine (II).

The ready availability of the diamide (I) makes this method an attractive synthetic route to xanthine and substituted xanthines. The reaction appears to be of a general nature, and its application to 1-*methyl*-



glyoxaline-4 : 5-*dicarboxyamide*, which may yield either 7- or 9-methylxanthine (or, less likely, both) is being examined. In a different connexion, the reaction has been applied to *quinoxaline*-2 : 3-*dicarboxyamide* (III) to give alloxazine (IV) in 60 per cent yield.

R. A. BAXTER.
F. S. SPRING.

University, Manchester.

[1] *Rec. trav. Chim.*, **10**, 4 (1891).
[2] Weidel and Roitner, *Monatsh.*, **17**, 174 (1896).
[3] Rinkes, *Rec. trav. Chim.*, **46**, 268 (1927).
[4] Gabriel and Sonn, *Ber.*, **40**, 4857 (1907). Cf. Kuhling, *Ber.*, **28**, 1968 (1895). Kuhn and Cook, *Ber.*, **70**, 761 (1937).

Loss of Inorganic Constituents on Combustion of Coal and Coke

THE standard method for preparing coal and coke ash for analysis is to burn off the carbonaceous matter by placing the sample in a silica tray contained in a muffle furnace heated to 800° C. While this procedure clearly leads to the volatilization of a proportion of the sulphur, arsenic and other volatile elements, it has hitherto been considered a valid assumption that the whole of the sodium, potassium, calcium, magnesium, silica, iron, alumina and phosphorus contained in the fuel is also present in the ash.

Observations made in the course of an investigation relating to flue solids have led us to suspect the correctness of this assumption.

To decide the issue, coal and coke were fired in a bomb such as is used for calorific-value determinations or heats of combustion. By this method all the inorganic components of a fuel are retained in the bomb. Preliminary experiments indicate that, in the case of sodium or potassium, 0–60 per cent of the original content expressed as percentage of ash may be lost when the ash of a fuel is prepared by combustion in a muffle furnace kept at 800° C. with free access of air. The bomb method of combustion for the concentration of the inorganic constituents of a fuel is a valuable technique which may reveal the presence of unsuspected elements, as well as the fact that certain elements are present in greater proportion than is usually thought. It may also reveal that determinations of elements (for example, phosphorus) by a method which depends upon their concentration in the ash by combustion of the carbonaceous material of a fuel are in error.

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A. O. PEARCE.

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July 28.

Metabolism of Gill Epithelium of a Freshwater Mussel

GRAY compared (1928) the chemical mechanism underlying rhythmic ciliary movement in mussel gills with that of muscle, especially the frog's heart, and found an essential similarity. Our knowledge of muscle chemistry, especially as regards the carbohydrate catabolism, has since increased considerably, and it appears worth while now to attempt a renewed comparison.

I have studied the epithelium of the gills of the freshwater mussel *Dreissensia*, which will retain its activity and oxygen consumption unaltered for at least 24 hours in ordinary fresh water after being cut off. When the gills are shaken in the Warburg apparatus, many cells will drop off, but even these will remain active.

As a basis for comparison, the nitrogen content has proved more suitable than either wet or dry weight. 13 per cent of the nitrogen found is located in the gill skeleton, the rest in the epithelium, and the gills on the two sides of the animal correspond within 3 per cent. The oxygen consumption per mgm. N/hour at 20° C. is 18·7 μl. and the *R.Q.* 0·87 with a standard deviation of 0·04.

Ciliary movements are inhibited in about an hour by 25 millinormal sodium fluoride and in 45 minutes by 3·3 millinormal monoiodoacetamide, but not at all by phloridzin in concentrated solution. All these determinations were made at 20° and *p*H 7·5–7·6. Complete lack of oxygen stops the cilia in 30 min. at *p*H 6·5, but the effect at *p*H 8·5 is slight only. This agrees with a finding by Clark and Eggleton (1938) that the anaerobic formation of lactic acid in the frog's heart is inhibited at acid reactions.

Tests were made to find out whether lactic acid was formed in the ciliary epithelium under anaerobic conditions at *p*H 8·5, but while a considerable amount of acid was formed, as shown by the liberation of carbon dioxide in the Warburg vessels, the special test for lactic acid (Koenemann, 1940) showed no increase whatever.

An attempt was made to isolate the acid by extraction with ether after precipitation of proteins. It turned out to be volatile and to smell like lower fatty acids, but sufficient material for chemical identification was not obtained.

When the ethereal solution was shaken with normal caustic soda and this afterwards titrated electrometrically with 0·1 *N* hydrochloric acid, the titration curve showed a definite inflexion at *p*H 5, again indicating that the substance differs from lactic acid which shows a *p*K of 3·9.

Lower fatty acids are produced by anaerobiosis in certain animals, notably valerianic acid in *Ascaris* (Weinland, 1901), and several formulæ have been proposed to account for their formation from sugar. These require the simultaneous formation of carbon dioxide, which was observed also in the case of *Ascaris*, but corresponding tests on *Dreissensia* gills gave a negative result. No carbon dioxide was produced anaerobically from half the gills of four animals in 5–7 hours as compared with the other half, determined at the beginning of the period.

On the other hand, it was shown by similar comparisons that glycogen, found to make up about 1·5 per cent of the fresh weight, disappears from the gills both in aerobic and in anaerobic metabolism, but at about three times the rate during anaerobiosis. The glycogen disappearing is only partly catabolized, as reducing substances are found in the medium at the end of the experimental periods.

The respiratory quotient of 0·87 shows that some other substance than carbohydrate must be regularly catabolized, and a definite formation of ammonium proportional to the oxygen consumption was observed.

The experiments are to be continued, but so far as they go they are sufficient to show that the metabolic mechanism supplying energy for the ciliary movements in *Dreissensia* differs definitely from that of muscular contraction in vertebrates.

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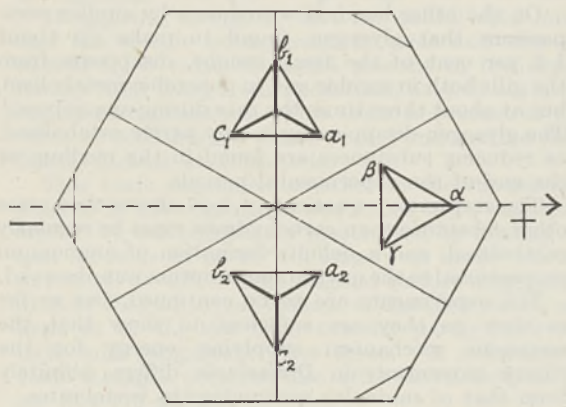
Stockholm. July 30.

Orientation of the Etching Figures of Quartz

THE etching figures produced on quartz crystal by hydrofluoric acid are different on surfaces cut in different orientations. The case in which the surface is normal to the optic axis is particularly interesting, since with such a surface, the etching pattern obtained consists of a great number of projecting triangular pyramids. This fact, first observed by Leydolt[1], was afterwards studied by Molengraf[2] and more recently by H. Arsandaux[3], Pan Tcheng-Kao[4] and A. de Gramont[5]. It is generally accepted that the three heights of the equilateral triangular base of each pyramid are respectively parallel to the three electric axes of the quartz, and that the three vertices of the base point towards the positive extremities of these axes when the crystal is under compression. A. de Gramont[6] asserted that the parallelism between the orientation of the elementary pyramids and the bisectors of the angles formed by the hexagonal prism of quartz is not always true and that a deviation of a few degrees may sometimes be found. According to this author, the directions of the pyramids and not those of the bisectors represent the true directions of the electric axes of quartz.

In the course of investigating the effect of ultra-violet radiations on the etching figures of quartz, I have carefully compared, by means of a high-precision micrometer, the orientation of these pyramids with the edges of the cross-section of the hexagonal prism. Measurements were performed on a number of plates cut from different crystals of Brazilian quartz. In contradiction to the observations of previous workers, the three basal heights of the pyramids are by no means parallel to the three directions of the bisectors of the angles of the hexagonal cross-section. As a matter of fact, the angle formed by them is 30°, with some possible variations of only a few degrees; in other words, the pyramids are directed to the mechanical axes rather than to the electric axes of quartz. For left-handed quartz, the directions of the three basal heights of a pyramid are orientated clockwise by 30° with reference to the positive extremities of the three compression electric axes, while for the right-handed quartz the orientation is anti-clockwise, as shown diagrammatically in the illustration.



THE REGULAR HEXAGON REPRESENTS A CROSS-SECTION OF THE HEXAGONAL PRISM OF QUARTZ. FOR A LEFT-HANDED CRYSTAL, THE PYRAMIDS OF CORROSION ARE ORIENTED AS a_1, b_1, c_1, AND FOR A RIGHT-HANDED CRYSTAL AS a_2, b_2, c_2. THE PYRAMIDS ARE BY NO MEANS ORIENTED AS $\alpha\beta\gamma$ AS GENERALLY BELIEVED.

A. Langevin[7] has investigated, by the method of etching, the quality of a number of old piezo-electric quartz plates used in the Laboratoire Curie and the Ecole de Physique et Chimie of Paris. He concluded that the plates which gave low values of the piezo-electric constant were due to the existence of electric twinning, which could not be detected by the plate-makers of the past, who used only optical methods for the selection of plates, and that for plates free from this twinning the values of the constant were found to be very consistent, having as a mean $7{\cdot}05 \times 10^{-8}$ C.G.S. unit. In this connexion, it is interesting to mention the result of A. de Gramont[6]. This author, using the same method of selection as Langevin, found $6{\cdot}38 \times 10^{-8}$ C.G.S. unit instead of $7{\cdot}05 \times 10^{-8}$ as the piezo-electric constant of plates of the best quality. This discrepancy is too great to be accounted for by the ordinary experimental error. It may very probably be caused by the difference in the choice of direction of electric axis of the plates used; since for the determination of this axis A. de Gramont relied on the orientation of the elementary pyramids rather than on the geometrical form of quartz.

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* In orthodox romanization, Chung Shêng-Piao.

[1] Leydolt, *Sitz. K. Akad. W. Math. Naturw.*, 59 (1855).
[2] Molengraf, *Z. Kryst. u. Min.*, **14**, 173 (1888).
[3] Arsandaux, H., *Bull. Soc. Franc. Min.*, **51**, 166 (1928).
[4] Pan Tcheng-Kao, *Rev. d'Optique*, **10**, 153 (1931).
[5] de Gramont, A., *Rev. d'Optique*, **10**, 213 (1931).
[6] de Gramont, A., "Recherches sur le Quartz Piezoelectrique", 22, 52 (1935).
[7] Langevin, A., *C.R. Acad. Sci.*, **209**, 627 (1939).

Collapse of Determinism

MANY readers of *Nature* will have noted with interest Prof. H. T. H. Piaggio's clear and dispassionate article on the "Collapse of Determinism"[1]. Of particular interest is the statement, "But a third interpretation goes so far as to claim that the existence of causality is disproved". This, of course, was the theme of Prof. E. T. Whittaker's Guthrie Lecture[2]. His arguments, however, are open to serious criticism, and there has been a tendency to throw the onus on Von Neumann's mathematical demonstration[3]. This, however, is also under criticism[4] and there are many who, knowing how easily assumptions can lurk in analytical work, refuse to be mathematically bludgeoned. Harm can be done to the reputation of science by any who proclaim as a definite doctrine what is but a tentative effort.

In Prof. Piaggio's last paragraph he remarks, "Some philosopher-physicists welcome these conclusions as giving us a hope of escape from the tyranny of an iron law of causation and assuring freewill to mankind as well as to electrons!" That, of course, is quite true: one all too often hears the view expressed. Nevertheless, to jump to talk of the "freewill of mankind" after having just talked only of electrons, and without noticing that there has been thrown into the equations an entirely unknown function called 'mind', is 'philosophy' of a type which surely even Thomas Aquinas would not have thought worthy of consideration.

Certainly many chapters of our physical knowledge can be neatly summarized in terms of causal laws. Some other chapters can at present best be summarized in quite different ways. Many physicists feel, however, the same dissatisfaction about these methods as the directors of a successful insurance company, run on statistical lines, might feel about their knowledge of the pathology of mortal diseases. In any event it is of very great interest to know if there exists even so much as a single instance where, by common consent, causal explanations can be definitely ruled out. Until then it would appear highly necessary to refrain from imposing our preconceived ideas, whatever these may be.

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[1] *Nature*, **154**, 122 (1944).
[2] *Proc. Phys. Soc.*, **55**, 459 (1943).
[3] "Math. Grundlagen der Quanten-Mechanik" (1932).
[4] *Proc. Phys. Soc.*, **56**, 195 (1944).

THE views of Prof. West on the interpretation of the Uncertainty Principle are very similar to my own. However, in writing on a controversial subject, I considered it necessary to mention all interpretations given by eminent authorities. In cases where I personally was not convinced of the accuracy of such views, I used the phrase "goes so far as to claim", and when my objection was very strong indeed, used an exclamation mark. Prof. West's list of references will be useful to readers who wish to form their own opinion on a subject of great interest to both science and philosophy.

In conclusion, I wish to put forward a general argument against all supposed demonstrations of an impossibility, such as Von Neumann's. However careful the logic, at best all that has been demonstrated is that the impossibility holds for the problem as formulated. Other lines of approach, not yet considered, may correspond more accurately to the phenomena, and may lead to a positive result.

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A Siderite of the Fourteenth Century

IBN-BATTŪTAH, the famous globe-trotter of the Middle Ages, in his travels from Tangier to China and West Africa (A.D. 1325–54), on reaching Birgi (the ancient Pyrgion in the valley of the Cayster—not far from the old Ephesus in Asia Minor), some time after 1332, was asked by the local sultan if he had ever seen a 'stone' "that had fallen from the sky". When he replied in the negative, the sultan showed him the 'stone' that had fallen some time ago outside the town, and ordered four stone-breakers to strike it vigorously with iron hammers. They did so, but with no effect. It weighed about a hundredweight and was "very hard with a glitter in it"[1]. All this goes to suggest that it must have been a siderite. This fall is not mentioned in the list given in H. H. Nininger's "Our Stone-Pelted Planet"[2].

It is interesting to note that Dr. J. Astapowitsch, of the Sternberg Astronomical Institute of Moscow, in his letter to me dated July 27, 1937 (in response to my request to make inquiries about the sword presented to Tsar Alexander I of Russia by James Sowerby, made from the Cape of Good Hope siderite[3]), wrote to say he could find no trace of this sword; "but among the meteorite collection of the Lomonossow Meteorological Institute there is a yataghan (Turkish sword without cross-piece) about 60 cm. long from an unknown siderite. It belonged formerly (in the 19th century) to a merchant in Siberia".

In all probability this yataghan was made for a later sultan or Mongol chieftain from a siderite that had actually been seen to fall—*perhaps* from this Birgi one when its true nature was revealed. It would be of interest to ascertain the history of this yataghan prior to the nineteenth century. The fact that "Caliphs and Mongol Chiefs had caused swords to be forged from recently fallen meteoric 'stones'" was well known to scientific men like Alexander von Humboldt[4].

Iron meteorites that have been seen to fall are rather rare.

MOHD. A. R. KHAN.

Begumpet,
Deccan.
June 15.

[1] Gibb, H. A. R., "Ibn Battūta's Travels" (London: George Routledge), 134.
[2] Boston and New York: Huffton Mifflin and Co., 1933.
[3] *Phil. Mag.*, **55**, No. 251 (1820); *Nature*, **135**, 39 (1935).
[4] Bonn, Henry G., "Cosmos", vol. 1 (London, 1849), 124.

Prof. W. E. H. Berwick

MAY I supplement Prof. Davenport's notice of his predecessor[1] to put on record an important service to mathematics which I was in a position to witness?

About fourteen years ago, Prof. Berwick suggested that the British Association Committee on Mathematical Tables should apply part of a bequest from Lieut.-Colonel Cunningham to the preparation and publication of a table of cycles of reduced ideals in quadratic fields. The computation of such a table is not a matter of pure routine, and could not be attempted by an operator who did not understand what he was doing; a mathematician was wanted. Fortunately, the late Dr. E. L. Ince, just returned to England from Cairo, was free to carry out the work, and he was a skilled computer as well as an exceptionally fine mathematician. The theory of ideals was a new subject to Ince, and Berwick undertook to initiate him. If, characteristically and irritatingly, Berwick underestimated the ease with which a mathematician of Ince's quality could master the elements of the theory, his own labours were the greater. He spared himself no pains, he improvised details of notation and arrangement, and he kept in close touch with the work from start to finish. The table, which appeared in 1934, properly bears Ince's name alone, but it owes a very great deal to Berwick's generous and enthusiastic help.

Stories of Berwick will be told as long as any of his contemporaries are alive to tell them; and we shall not forget that the arrogance of which we are making kindly fun was the arrogance that refused to acknowledge defeat in the presence of overwhelming physical disaster. Many times Berwick fell prone from his great height; not once did he stoop.

E. H. NEVILLE.

The University,
Reading.
Sept. 4.

[1] *Nature*, **154**, 265 (1944).

GESTURE ORIGIN OF SEMITIC LANGUAGES

By PROF. ALEXANDER JÓHANNESSON
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IN *Nature* of February 5, I gave a summary of my researches regarding the origin of human speech as set out in my book "Um frumtungu Indógermana og frumheimkynni: On the primitive speech of the Indo-European people and their first home" (University Reykjavik, 1943). I tried to prove that the most important class of the 2,200 constructed Indo-European roots could be explained as imitation by the organs of speech of the movements of the hands. As my conclusions agreed with those propounded by Sir Richard Paget in his work "Human Speech" (1930), I published my researches. I have succeeded in adding much new material, not yet published, to my gesture theory. I was interested to see whether my conclusions for the Indo-European languages were confirmed or not in the Semitic group. I therefore undertook an examination of Hebrew (published in June in the Icelandic periodical *Eimreiðin* under the title "Hebrew and Icelandic"). The result was surprising: as many as 60 per cent of the Hebrew roots could be explained by my own rules for the Indo-European languages.

As Pre-Semitic must be a starting point, just as Pre-Indo-European is, I chose those sounds where Hebrew shows no divergence from the Pre-Semitic. I began with *d*, *t*, *th* in Hebrew. Roots in Indo-European beginning with dentals show the predominant meaning "to touch, retain, destroy (the first man either pressed his teeth together or let the tip of the tongue rest against them), extend, draw (in this case the tongue has been drawn back from the teeth to the palate)". In Hebrew many roots beginning with dentals signify "to smash, destroy, force": *dabl*, press together; *dbs*, paste together; *dvs*, tread down; *dka*, subdue; *dkh*, smash; *dkk*, break, smash; *dyk*, destroy; *dchq*, press, drive; *dqq*, smash; *tbch*, kill, slaughter; *tby*, press into something; *thphph*, beat the drum; *thqy*, clasp one's hands; *trph*, tear; *thkk*, subdue, smash, break; *thmk*, grasp, hold tight, etc. Many 'dental' roots signify to extend, draw: *dag*, be sad (get contracted); *dgl*, hoist a flag (*l* is the movement of the tongue to the palate); *dvk*, tear away; *djg*, draw up a fish; *dchh*, push (draw away); *tvh*, spin; *tvch*, cover (drag over); *tchh*, throw away; *tchch*, cover; *tyh*, lead astray; *tphch*, get expanded; *trch*, throw burdens on something, etc.

l in Ide. signifies especially "to move, withdraw, glide slowly, devour, lick, play, lie without movement". In Hebrew: *lhm*, devour; *lchd*, lick; *lyt*[2], devour eagerly; *lyg*[2], imbibe noisily; *lqq*, lick. Further: *dlg*, spring, play; *dlh*, hang relaxed; *dll*[1], be limp; *dll*[2], be slack, of slowly running water; *dlph*, leak, drip; *tbl*[1], immerse in water; *tla*, put a spot on something; *tll*[2], sprinkle; *thla*, hang up; *thlh*, hang on gallows; *thll*[1], heap up gravel; *thll*[2], betray (play a trick with one). Most Hebrew roots consist of three consonants, and it is clear from these and other examples that it is not always the first consonant that determines the meaning, this depending on the varying emphasis of the sounds.

r in Ide. signifies especially "to put in movement, make noise, erect". In Hebrew: *rvd*, roam; *rbk*, stir about; *rgy*[1], be in turbulent movement; *rhh*, be excited; *rkb*, ride. Further: *dbr*, drive; *dhr*, drive (horses); *dvr*, turn round; *dqr*, pierce; *dra*, push away; *drg*, pace, walk; *drr*, run incessantly; *trd*, drive away, etc.

m is formed by closure of the lips and should therefore signify "to finish, be silent", or something similar. This meaning appears seldom in Ide. In Hebrew: *dvm*, keep silence; *dmh*[2], be quiet; *dmm*, become silent (from fright); *dmn*, manure (put cover on); *tym*, taste; *thmm*, be perfect, have finished.

Of 138 roots beginning with *d*, *t*, *th* in Hebrew, the gestural origin is seen in 51 roots: *l* in the middle or final position decides the meaning in 15 roots; *r* in middle or final position in 11 roots; *m* in the middle or final position in 7 roots. Thus 84 of 138 roots (60 per cent) are evidently gestural.

Similar results are obtained by examining other sounds. The *s* roots in Ide. often signify "to run" (of water or fluid). In Hebrew: *svch*[1], flow away; *svch*[2], sink down or in; *suph*, rush; *svph*, float, swim; *sqq*, sieve (a juice); *svb*, flow, run; *skk*, sink down (of water); *snr*, conduct water; *srh*, be moist.

The relationship between Ide. and Semitic, which has been suggested for hundreds of years, is not accepted by the majority of philologists to-day. The possibility of relationship is not denied (Herm., Hirt and others). If the gesture theory is right, this doubtful question becomes clear. The first Indo-Europeans as well as the first Semitic people began to speak by imitating the signs of the hands with their speech organs. This primitive state of speech shows clearly in many Ide. and Semitic words, which apparently seem to be of the same origin (comp. Herm. Möller's comparative Ide.-Semitic dictionary). A common origin is possible. But if the constructed Pre-Indo-European language is compared with the constructed Pre-Semitic language and the different development of these two groups is kept in mind, a common origin must be at least 10–20,000 years old. A systematic research of all available Semitic material from this new point of view is now needed.

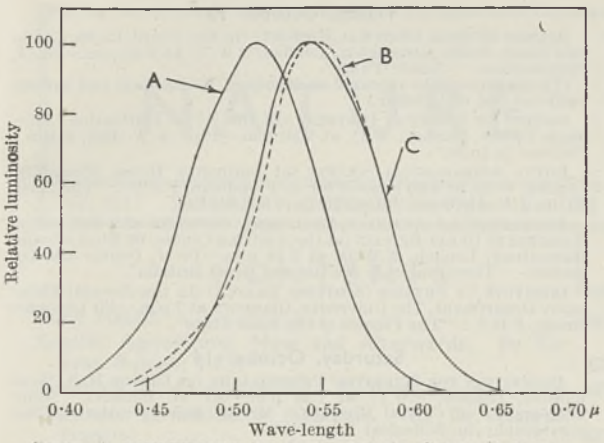
[1,2] Different meanings of the same root.

MONOCHROMATISM*

By DR. F. H. G. PITT
Kodak Research Laboratories

MONOCHROMATISM is a type of colour-vision deficiency in which the observer, a monochromat, can match any colour by any other colour, merely by the adjustment of their intensities. It is a very rare form of colour-vision deficiency, its frequency of occurrence in the male population being stated to be so low as 0·0003 per cent[1], as compared with 6 per cent for anomalous trichromatism and 2 per cent for dichromatism. Of this rather tentative 0·0003 per cent, nearly all the recorded cases are monochromats by virtue of their having no cone-vision. Such persons, whose defect is usually described as cone-blindness, rely solely on the functioning of the rods in the retina, and suffer from other ophthalmological defects such as low visual acuity and nystagmus. As might be expected of persons using a mechanism which, in normal persons, only functions when the eyes are dark-adapted, they suffer

* Comm. H982 from the Kodak Research Laboratories, Wealdstone, Harrow, Middlesex.



CURVE *A*, MONOCHROMAT (NO CONE VISION); CURVE *B*, MONOCHROMAT TYPE II; CURVE *C*, *G'* FUNDAMENTAL SENSATION CURVE.

from photophobia or fear of the light. The luminosity curve for this type of monochromat is shown (Curve *A*) in the accompanying graph[2]. It is very similar to the scotopic luminosity curve for the normal eye. Whether such persons may be classed as colour-blind in the accepted sense of the word is a fine point; if they are accepted as such, then there is no logical reason why totally blind persons should not also be classed in the same way.

Recently, I came across a person who, although a true monochromat, did not suffer from the visual defects associated with the previously mentioned type of monochromat. He had passed the Army visual tests, and a confirming test showed that he had visual acuity well above the normal. His particular duties had proved him to be a very able photometrist. When tested with the Ishihara charts, the American Optical Company's Pseudo-Isochromatic plates, and a test for dichromatism and anomalous trichromatism devised by Mr. R. B. Morris of these Laboratories, he reacted as a typical protanope, and in the first two tests read the letter, which purports to detect the monochromat, with ease. He would have been classed as a protanope had he not casually mentioned that he sometimes had difficulty with the blues. A test on a Donaldson colorimeter showed that he could match any colour with any other colour, thus confirming monochromatism. A further test, performed on special apparatus, also devised by Mr. Morris, showed that his visual recovery curve, after adaptation, was almost identical with that of a normal observer and confirmed what was suspected, namely, that the observer possessed cone-vision.

By kind permission of Dr. W. D. Wright, the full luminosity curve of this observer was measured on the Wright colorimeter[3], which uses a test field subtending an angle of 2°. In the experiment, one half of the field was illuminated by light of wave-length 0·53 μ, which could be varied in intensity, and the other half by light of wave-length λ_1. The observer was asked to match the two colours as accurately as possible for various values of λ_1, throughout the visible region. This gave Curve *B*, which is similar to the protanopic luminosity curve and accounts for the fact that the observer reacted as a protanope to the three previously mentioned colour-vision tests. Colour matches, made by a normal observer for white and at various wave-lengths throughout the spectral range, were also perfect matches for this monochromat, proving that this form of monochromatism is a reduced form of normal trichromatism.

Although this monochromatic luminosity curve is very similar to the protanopic luminosity curve, it should be noted that the blue (*B'*) fundamental sensation curve[4] modifies the luminosity curve in a minor degree only. The green (*G'*) fundamental sensation curve[4] (Curve *C*) bears a like similarity, and it is therefore concluded that the observer suffers from protanopia, in which the red (*R'*) fundamental sensation curve is missing, and also from tritanopia in which the *B'* sensation curve is missing[4]. (Judd[1] mentions, without giving any supporting evidence, that a monochromat of this class is born with protanopia and acquires tritanopia later. This acquirement of tritanopia is neither confirmed nor disproved in the case under discussion.) If the conclusion is correct, this form of monochromatism could also be classed as one of double dichromatism, and it follows that, from dichromatic data, we could forecast the possible forms of monochromatism, and, if the dichromatic data were correct, estimate the probability of occurrence. Listed below are the three well-known forms of dichromatism, designated by the names suggested by v. Kries, the reason for the deficiency[4], and the reported occurrence[1]. Another form, called tetartanopia by v. Kries, is suggested by the theories of Hering and Müller, but practical information regarding it is almost non-existent, and what is available suggests that it may be tritanopia recorded on inaccurate apparatus.

TABLE 1.

Type	Reason for deficiency	Occurrence
Protanopia	Absence of *R'* fundamental sensation	1 per cent
Deuteranopia	Fusing of *R'* and *G'* fundamental sensations	1·1 ,,
Tritanopia	Absence of *B'* fundamental sensation	0·0001 ,,

From these three forms of dichromatism we obtain the following two possible forms of monochromatism, omitting, of course, the form due to cone-blindness:

TABLE 2.

Type	Reason for deficiency	Probability of occurrence
Monochromat I	Absence of *B'* fundamental sensation accompanied by the fusing of the *R'* and *G'* fundamental sensations (tritanopia and deuteranopia)	0·0000011 per cent
Monochromat II	Absence of *R'* and *B'* fundamental sensations (protanopia and tritanopia)	0·000001 ,,

It is interesting to note that the reason for the deficiency given in Table 1 does not logically permit the occurrence of both protanopia and deuteranopia —if it did it would merely be protanopia. If deuteranopia were not caused by the fusing of the *R'* and *G'* sensations, a third class of monochromat would occur, having a probability of occurrence as high as 0·001 per cent, and would undoubtedly have been discovered. The fact that such a discovery has not been made supports the suggested reason for the deficiency, as given in Table 1.

According to Judd (ref. 1, p. 297), the two forms of monochromatism are postulated by one theory only, namely, that due to G. E. Müller, who classifies them as Inner Total Colour Blindness, Type I and

Type II (Type I, as postulated by v. Kries and Hering, being vaguely described as acquired total colour blindness and total colour blindness respectively). As the method of approach followed in this communication is strictly in accordance with the principles laid down by the Young-Helmholtz theory, which in a slightly modified form fully accounts for dichromatism[4], there is no reason why this latter theory should not be extended to cover monochromatism. Type I would be classified as blue-blindness with red and green fusion, Type II as blue and red blindness. Persons having Type I defect would produce a luminosity curve similar to the deuteranopic luminosity curve, but with the relatively small ordinates of the blue luminosity curve subtracted. Such persons have been reported previously, but full luminosity values do not appear to have been measured although the maximum of their luminosity curve is stated to be at $\lambda = 0{\cdot}56\,\mu$, which is in agreement with the above postulate. Persons having Type II defect will produce a luminosity curve as given in the accompanying graph. No other types of monochromat are suggested by any theory or have been reported.

It may be that the recorded occurrence of tritanopia, namely, 0·001 per cent, does not represent the true value, and that this apparently low figure is due in some measure to the fact that the usual forms of colour-vision tests do not adequately cater for this defect. If this is so, the probability of the occurrence of the two forms of monochromatism, namely, one person in every one hundred million, is also too low. Once again the nature of the colour tests normally used would tend to obscure the true figure.

[1] Judd, D. B., *J. Opt. Soc. Amer.*, **33**, 294 (1943).
[2] Wright, W. D., and Granit, R., "On the Correlation of Some Sensory and Physiological Phenomena of Vision". (Published for the *Brit. J. of Ophthalmology, Ltd.*) (George Pulman, London, 1938.)
[3] Wright, W. D., *Trans. Opt. Soc. London*, **29**, 225 (1927).
[4] Pitt, F. H. G., *Proc. Roy. Soc.*, B, **132**, 101 (1944).

FORTHCOMING EVENTS

Saturday, October 7

GEOLOGISTS' ASSOCIATION (at the Geological Society of London, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Mr. A. D. Lacaille: "The Northward March of Palæolithic Man in Britain".

Monday, October 9

BRITISH MUSEUM (NATURAL HISTORY) (in the Board Room, Cromwell Road, South Kensington, London, S.W.7), at 2.30 p.m.—Dr. J. Ramsbottom: "Edible Fungi".

CHEMICAL SOCIETY (LEEDS AREA LOCAL SECTION) (in the Chemistry Lecture Theatre, The University, Leeds), at 6.30 p.m.—Dr. W. H. Thompson: "Some Trends in Chemical Spectroscopy and the Study of Large Molecules".

Tuesday, October 10

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Mr. H. N. C. Stevenson: "The Case for Applied Anthropology in the Reconstruction of Burma".

ILLUMINATING ENGINEERING SOCIETY (at the E.L.M.A. Lighting Service Bureau, 2 Savoy Hill, London, W.C.2), at 5 p.m.—Mr. E. Stroud: Presidential Address.

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield, 1), at 6.30 p.m.—Mr. W. H. Salmon: "The Metallurgist in the Foundry".

Wednesday, October 11

BRITISH MUSEUM (NATURAL HISTORY) (in the Board Room, Cromwell Road, South Kensington, London, S.W.7), at 2.30 p.m.—Dr. J. Ramsbottom: "Edible Fungi".

INSTITUTION OF ELECTRICAL ENGINEERS (RADIO SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. H. L. Kirke: Inaugural Address as Chairman.

Thursday, October 12

INSTITUTE OF FUEL (at the Connaught Rooms, Great Queen Street, London, W.C.2), at 2.15 p.m.—Dr. E. W. Smith: Melchett Lecture.

INSTITUTION OF ELECTRICAL ENGINEERS (INSTALLATIONS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. G. O. Watson: Inaugural Address as Chairman.

Friday, October 13

BRITISH MUSEUM (NATURAL HISTORY) (in the Board Room, Cromwell Road, South Kensington, London, S.W.7), at 2.30 p.m.—Dr. J. Ramsbottom: "Edible Fungi".
(The lecture will be repeated on Mondays, Wednesdays and Fridays until the end of October.)

SOCIETY OF CHEMICAL INDUSTRY (at the Royal Institution, Albemarle Street, London, W.1), at 2.30 p.m.—Prof. A. V. Hill, F.R.S.: "Science in India".

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Prof. J. Proudman, F.R.S.: "The Tides of the Atlantic Ocean" (George Darwin Lecture).

ASSOCIATION OF AUSTRIAN ENGINEERS, CHEMISTS AND SCIENTIFIC WORKERS IN GREAT BRITAIN (at the Austrian Centre, 69 Eton Avenue, Hampstead, London, N.W.3), at 6.45 p.m.—Dr. J. Coutts and Dr. Medwei: "Therapeutics in Austria and Great Britain".

INSTITUTE OF PHYSICS (SCOTTISH BRANCH) (in the Natural Philosophy Department, The University, Glasgow), at 7 p.m.—Sir Lawrence Bragg, F.R.S.: "The Physics of the Solid State".

Saturday, October 14

ASSOCIATION FOR SCIENTIFIC PHOTOGRAPHY (at Caxton Hall, Westminster, London, S.W.1), at 2.30 p.m.—Mr. H. Emmett: "Cinemicrography of Crystal Growth"; Mr. R. McV. Weston: "Cinemicrography in Biological Research".

APPOINTMENTS VACANT

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

ASSISTANT ENGINEERS for the British Guiana Government Public Works Department—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E.1055.A) (October 9).

TUTOR OR ASSISTANT TUTOR (temporary) IN THE DEPARTMENT OF SOCIAL SCIENCE of the London School of Economics and Political Science—The Acting Secretary, The Hostel, Peterhouse, Cambridge (October 12).

ASSISTANT IN THE MECHANICAL AND ELECTRICAL ENGINEERING DEPARTMENT—The Principal, Harris Institute, Preston (October 12).

SCIENCE LECTURER (full-time) IN THE DEPARTMENT OF BUILDING of the Liverpool Technical College—The Director of Education, 14 Sir Thomas Street, Liverpool, 1 (October 13).

LECTURER (temporary) IN THE SCIENCE DEPARTMENT of the Croydon Polytechnic—The Education Officer, Education Offices, Katharine Street, Croydon (October 13).

ENGINEER (suitably qualified and experienced) for a full-time post in connexion with Production Engineering Courses, and an ENGINEER (suitably qualified and experienced) for a full-time teaching post in connexion with Ordinary National Certificate and Higher National Certificate Courses in part-time day and evening classes, in the Department of Mechanical and Automobile Engineering of Doncaster Technical College—The Chief Education Officer, Education Offices, Doncaster (October 14).

ASSISTANT SPEECH THERAPIST (whole-time)—The Chief Education Officer, 2 Cecil Road, Bristol 8 (October 14).

LECTURESHIP IN THE ENGINEERING DEPARTMENT of the County Technical College, Wednesbury—The Director of Education, County Education Offices, Stafford (October 14).

RESEARCH ASSISTANT IN THE VETERINARY LABORATORY of the AGRICULTURAL DEPARTMENT—The Registrar, King's College, Newcastle-upon-Tyne (October 14).

RESPONSIBLE TEACHER OF ENGINEERING, an ENGINEERING WORKSHOP INSTRUCTOR AND STEWARD, and a TEACHER OF PHYSICS, in the Junior Technical School and in Senior Part-time Classes at the Batley Technical College and School of Art—The Director of Education, Education Offices, Batley, Yorks. (October 16).

CHIEF ENGINEER for the Town Council of New Amsterdam, Berbice, British Guiana—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.2296.A) (October 16).

CHEMICAL ENGINEER, experienced in design and installation of chemical manufacturing plant, for supervisory post in London—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.2292.XA) (October 16).

HEAD OF THE CHEMISTRY AND APPLIED CHEMISTRY DEPARTMENT—The Principal, Royal Technical College, Peel Park, Salford, 5 (October 16).

LECTURER (full-time) IN CHEMISTRY—The Director of Education, The Polytechnic, 309 Regent Street, London, W.1 (October 16).

ASSISTANT MASTER IN MINING SUBJECTS in the Coalville Mining and Technical College—The Director of Education, County Education Office, Grey Friars, Leicester (October 17).

TEACHER to take charge of BIOLOGY CLASSES and to assist with ELEMENTARY SCIENCE SUBJECTS—The Principal, Harris Institute, Preston (October 18).

PROFESSOR OF PHYSICS—The Registrar, University College, Singleton Park, Swansea (October 18).

ASSISTANT LECTURER IN THE MECHANICAL ENGINEERING DEPARTMENT of the Belfast College of Technology—The Director of Education, Education Office, College of Technology, Belfast (October 30).

CHADDOCK CHAIR OF ECONOMICS—The Registrar, The University, Liverpool (December 29).

LECTURER IN GEOGRAPHY at the Furzedown Training College (evacuated to the University of South Wales, Cardiff)—The Principal, 29 Corbett Road, Cathays Park, Cardiff.

TEACHER (male, Graduate) OF MATHEMATICS with, if possible, subsidiary GEOGRAPHY—The Principal, Technical High School, Cole Street, Scunthorpe.