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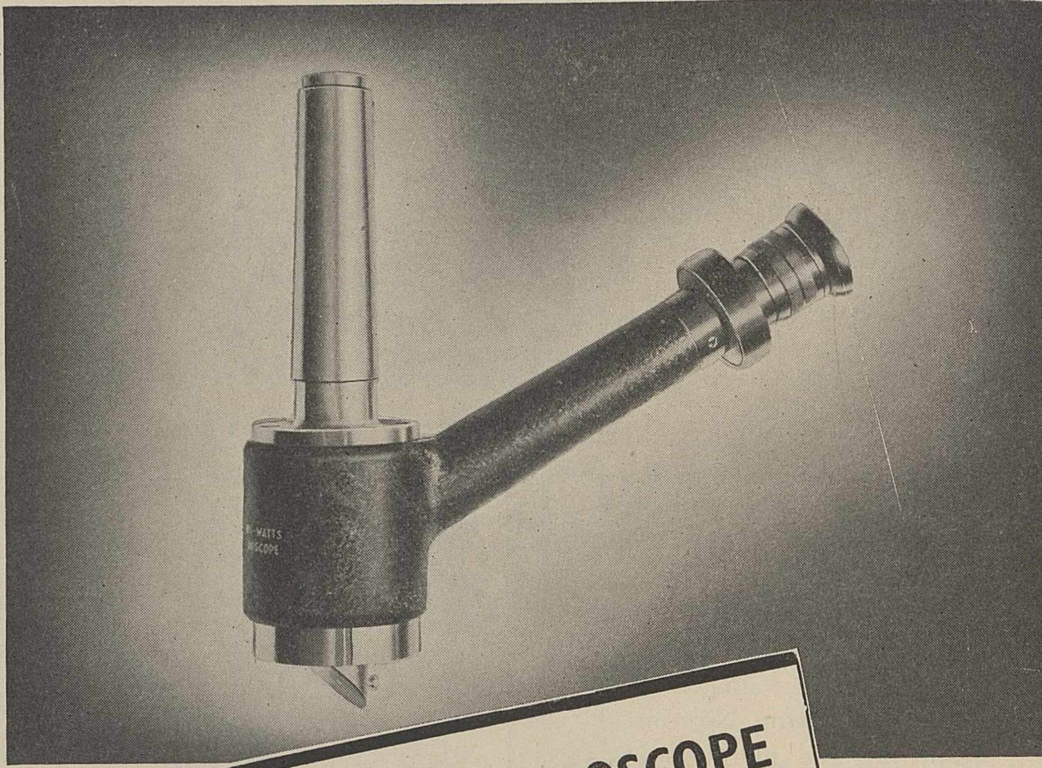

# NATURE

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# RECRUITMENT AND TRAINING OF TEACHERS

## TECHNICAL COLLEGES AND SCHOOLS

For many months past the pages of Nature have referred to the great demands that will be made upon the industrial resources of Great Britain in post-war years and the consequent need for trained technicians and technologists to cope with the gigantic problems involved. Though the general character of the requirements of the situation have been surveyed by a variety of industrial, commercial, professional and educational bodies, it remains largely to the Board of Education to promote and later implement specific proposals for bringing about the necessary improvements in education and training schemes in order to relate them to the practical and social needs of the community in the best possible way. It is therefore gratifying to find that the recent McNair Report* not only gives a courageous and penetrating analysis of present deficiencies in the training of technical teachers (Part III, p. 108) but also advances bold suggestions for tackling what is stated to be "a comparatively new field of enquiry".

The keynote is struck when the report urges that "the standard of technical training which can be offered to those already in, or about to enter, industry, necessarily depends upon an adequate supply of teachers of high capacity and with personal experience of current practice. This fact is basic. Technical teachers, regarded collectively, constitute a key group in industrial development, yet their importance has hitherto been scarcely recognised even by those industries which most directly depend upon them for a supply of trained workers."

As in other fields of education, so in the technical field, greatly increased numbers of teachers will be required to implement the new Education Bill; indeed for the compulsory part-time requirements alone some 2,000–3,000 teachers of the ordinary technical and commercial subjects will be required. To these must be added "some thousands of additional teachers" for the older industries, for example, building, not to speak of the needs of the newer industries such as "plastics and large-scale catering" and many aspects of commerce, for example, marketing and export, which have as yet scarcely been considered. A further most urgent matter is the desirability of lightening the load of the present teachers so that they may be able to carry out research or make essential contacts with industry whereby their teaching may become vitalized and stimulating. These are only a few among the many factors which make it necessary to provide for large increases in the recruitment of technical teachers and render it important to frame schemes of training whereby the recruits may not only become efficient teachers but also be enabled to bring into the lecture room and laboratory a realism which unfortunately is frequently lacking to-day.

Witnesses from the chemical industry told the

*See also Nature of May 20, p. 601, and May 27, p. 629.

Committee that many teachers of chemistry, in spite of their academic attainments, have insufficient knowledge of industry to adapt their methods to the needs of students ; in courses for the building industry many of the higher teaching posts are held by architects who have had little or no experience of practical building and allied trades ; textile industrialists often find that even graduates in technology are lacking in the groundwork of the fundamental sciences associated with their work. This latter criticism is also supported by the engineering world. "Commercial" teaching is often of a low order due to the use of antiquated systems and old-fashioned methods of instruction—a state of affairs which is inexcusable in view of the remarkable strides that have taken place in industrial administration in the last twenty years.

Worst of all, it is found that many technical teachers are ill-equipped to teach adolescents, and when it is remembered that, due to the association of junior technical schools with senior colleges, a given teacher under present conditions may have to teach boys of thirteen at one part of the day and lecture to honours degree students at another, it is seen that nothing short of a revolutionary treatment of the whole problem of the training of technical teachers will suffice.

The McNair Committee must be heartily congratulated for facing up honestly to these defects. It is true, of course, that some of the major deficiencies will disappear automatically upon the implementation of the Education Bill. Thus the junior technical school will be recognized for what it is, namely, an aspect of secondary education, and, as such, will come under secondary school regulations. The view that its past success is due to its pupils being taught by the same instructors as for senior students is, on examination, scarcely tenable. The McNair Report, therefore, in discussing the training of technical teachers, recognizes that "The establishment of compulsory part-time education with its vocational studies, and the provision of junior technical and commercial schools as a normal part of secondary education, will change the pattern of technical education and a much larger number of teachers of technical subjects will be required".

Little need be said about the recruitment of technical teachers in the past, for the majority seem to have drifted thither through the force of circumstances, there being no *ad hoc* recruiting ground or training available. Moreover, "the supply of technical subjects teachers ebbed and flowed with the prosperity or decline of industry. Teaching was to some extent a safe refuge from economic storms and, conversely, recruitment declined when teachers were most in demand". What about future recruitment ? Clearly, this will depend on making the conditions attractive and laying down a definite policy for higher technical education. It is perhaps in reference to this that the McNair Report reaches the high-water mark of realism, for it bases its recommendations upon the closest collaboration between industry, commerce and technical education. A supply of good and appropriate buildings and equipment, salary scales and opportunities of promotion comparable with those of industry, possibilities of frequent interchange between teaching and industry, not neglecting opportunities for gaining overseas experience and ample facilities for carrying out research, are among the improvements in conditions that are envisaged. "But however many and varied the opportunities for interesting work and experience may be in theory, teachers will not in practice take advantage of them unless the root obstacle is removed. That obstacle is that many teachers in technical and commercial colleges, and especially the more responsible members of the staff, are heavily loaded with teaching duties. They have no time to spare. . . . Some local education authorities or governing bodies impose too narrow an interpretation of what constitutes a full-time appointment."

It must not be assumed that because there will be a great shortage of technical teachers therefore all comers must necessarily be welcomed, for it has to be recognized that teaching is an art and demands a certain aptness and attitude of mind, for even mediocre success. The "elusive qualities of personality" are difficult to describe and assess, but apart from these there are four other qualifications which ideally every teacher should possess, and to these must be added a fifth in the case of the technical teacher, namely, (1) a general education which fits him to be an acceptable teaching member of an educational institution, (2) a high standard of knowledge of his subject, or of skill in his craft, (3) the ability to teach, (4) an appreciation of the relation of his own subject to other realms of knowledge and of his educational institution to society at large and, especially, (5) an intimate acquaintance with his subject in its industrial or commercial setting, if possible through the practical experience of having played a significant part in industry or commerce. The report makes it clear that without a high standard of knowledge of his special subject or skill and an awareness of its industrial or commercial applications, a teacher has no proper place in a technical college. With this we must fully agree. Some good work as a teacher, however, might be done by one who was thus qualified but whose general education was somewhat shaky ; this applies only to older persons who by virtue of wisdom and experience in other fields of human interest may be able to give useful teaching service, but for young teachers the full professional equipment is necessary. The point is, however, of importance in connexion with the emergency training schemes for dealing with the great demands for teachers in the immediate post-war years, and may conceivably be considered in connexion with the release of Service personnel, many of whom during the war period have had experience akin to that of teaching, for example, as responsible N.C.O.s or as service instructors.

The above emphasis on the importance of the possession of good technical qualifications does not imply that technical education is concerned wholly with imparting some 'skill', whether mental or practical ; on the contrary, the training is only the medium through which a particular attitude to life and the world in general is developed, that is to say, we must distinguish carefully between 'education' on one hand and 'training' on the other. It is true that the two cannot be entirely separated, but unfortunately it is possible so to stress the training that the educational process becomes of secondary importance, to the great disadvantage of the student. The report does well to emphasize this fundamental matter; indeed, the whole outlook of the report is refreshingly vitalized by its insistence on the *educational* functions of technical colleges. "The good technical teacher is no mere technician; he is also an interpreter of the modern world".

Quite the most inspired section on the training of technical teachers is that dealing with the part which industry must play. It is full of new ideas which, if carried out, will put technical education on a very high plane. Evidence shows that industry is ready and willing to play its part, and war-time contacts between colleges and industry have done not a little towards forging a close bond between the two. The nature of the bond is such that technical education and industry are co-equals. It is not therefore appropriate that the Board of Education should act as prime mover in securing co-operation but rather that the well-established and highly responsible professional institutions should take the initiative as intermediaries. These institutions already possess considerable experience of educational work and include among their members both teachers and acknowledged leaders of industry. They command the respect of all parties and between them cover a large part of the whole field divided up into its natural economic and technological units. Probably the formation of small standing advisory committees would be an effective means of keeping continuously in view the changing situation. The colleges themselves should be so closely linked with local industry that some of the teachers may even be associated with production in all its phases. Large firms might from time to time provide lecture courses and demonstrations in design and manufacturing processes. Experiments on these lines made to date have had remarkable success despite reluctance on the part of some industrialists to encourage the spread of their specialist knowledge. Furthermore, the release by industry of high-grade staff for part-time work in technical colleges would have advantages on both sides and would be of inestimable value to technical education, giving much-needed inspiration from the most powerful source from which the technical teacher can draw. What has been said about co-operation between the factories and the colleges applies equally to co-operation with research associations, which would confer great benefits upon technical teachers by holding refresher courses and visits to their laboratories for selected personnel.

A word must now be said regarding the arrangements for the actual training courses. "There is no generally accepted body of doctrine on the training of technical teachers, nor on the best methods of teaching some of the many subjects to the diverse types of students". The experience gained in Board of Education short courses has naturally been extremely suggestive, but there is still room for much further experiment. The report makes the valuable suggestion that "The time is now ripe for selected technical and commercial colleges and schools in association with teacher-training institutions to experiment . . . systematically and on a comprehensive scale". This training should, however, not be isolated from that of other teachers, and therefore should be undertaken by the area authority recommended elsewhere in the report, which should, for this purpose, include representatives of technical education in its constitution. The major part of the training should be carried out before the teacher begins to practise, for which purpose generous financial provision should be made, and in order to render the scheme flexible so as to deal with the vast range of interests involved, the course should be broken into units of comparatively short duration, for example, (1) education, (2) teaching, (3) study of the 'student', (4) industrial and commercial contacts. By conducting the course in conjunction with technical colleges, the services of experienced teachers would thus be effectively drawn upon and segregation of trainees would be avoided. "A liberal provision of refresher courses to make up for the comparativey short duration of the initial training period" would, of course, be necessary and would at the same time serve to correct any acquired errors of teaching technique and give encouragement to the young trainee.

It will be seen from the above that the McNair Report is a document of the greatest significance to technical education and one carefully calculated to remove the stigma resting upon it at present, namely, that "Technical education in this country has never received the attention it deserves and there has hitherto been no systematic provision for the recruitment or training of technical teachers".

In view of the key importance of technical education in our future national development, immediate steps should therefore be taken to provide the conditions for the implementation of the report at the earliest possible date.

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## HIGH POLYMERS

**High Polymers**

By Raymond M. Fuoss, J. Abere, W. O. Baker, Henry Eyring, John D. Ferry, Paul J. Flory, C. S. Fuller, G. Goldfinger, R. A. Harman, Maurice L. Huggins, H. M. Hulbert, H. Mark, H. Naidus, Charles C. Price, John Rehner, Jr., Robert Simha and A. V. Tobolsky. (*Annals of the New York Academy of Sciences*, Vol. 44, Article 4.) Pp. 263–444. (New York: New York Academy of Sciences, 1943.)

In spite of the difficulty in prosecuting academic work on high polymers during the War, there has almost been a flood of literature, both books and discussions, on this topic. The reason is not far to seek. In the immediate pre-war years the subject was just getting into its stride, and though the rate of progress has naturally been drastically cut down, many workers have been able to make a substantial contribution when an opportunity for discussion has arisen. In the volume under review, the Physics and

Chemistry Sections of the New York Academy of Sciences combined to stage a joint discussion to bring both the chemical and physical aspects of the subject into contact and, it is hoped, alignment. There were eight papers contributed to the meeting, with a general introduction by R. M. Fuoss. Some of the material is new, but the majority of the papers are reviews of published work.

The subject may fairly be divided into two parts; the first dealing with the mechanism of the synthesis of macromolecules, and the second with structure and its connexion with physical properties. The question of reaction mechanism is now fairly well understood in its broad outlines, although there are many absolutely fundamental questions which have hitherto evaded solution. The two main processes of molecular growth comprise: (*a*) those in which each step in the addition of the monomeric unit is kinetically similar, although there may be small changes in the energy of activation and in the temperature-independent factor of the velocity coefficient as molecular size increases; (*b*) those formally similar to the classical chain reactions of kinetics. Generally, it would appear that stepwise growth is confined to poly-condensation reactions. In view of the apparent kinetic simplicity, it might be expected that the study of such reactions would give detailed information as to how velocity coefficients change with molecular size. The unfortunate trouble is that poly-condensations almost invariably occur in very concentrated solutions or between the two components alone, and therefore it is not easy to compute the magnitude of velocity coefficients. However, it is possible to measure the average energy of activation of the reaction and also to measure the distribution of molecular weights about the mean value. By postulating that the velocity coefficient does not depend on molecular size, it is rather interesting to note that the form of the distribution curves may be accounted for. The details of the various calculations are given in the review by Abere, Goldfinger, Mark and Naidus. What is not known with any great certainty is the extent to which the shape of the distribution curve is dependent on a variable velocity coefficient, for at present there is no reliable experimental information as to the nature of such a variation.

By far the greatest part of the experimental and theoretical work has been devoted to those reactions exhibiting chain-like characteristics. The classical chain theory has naturally been of immense value in quickly clearing away the preliminary difficulties, so that a real attack may be made on the problems peculiar to polymerization kinetics. Both the above-mentioned paper and another comprehensive review by Hulbert, Harman, Tabolsky and Eyring deal in some detail with the ideas now fairly well established in this part of the subject. They need not be referred to here. It is perhaps worth while, however, mentioning some of the difficulties. In those reactions where the time for the growth of the polymer is short compared with the half-life of the monomer, the expression for the velocity of reaction contains the three coefficients for starting propagation and termination of growth. The problem is to determine the numerical value of each coefficient. In general, however, we may only observe *two* significant things about the reaction; for example, the velocity and chain-length. One cannot, therefore, obtain the individual values of these coefficients and examine further how such coefficients vary with molecular length. Theoretically, it is possible to calculate the shape of the distribution curve according to various assumptions regarding the mechanism of these reactions and the variation of coefficients with size. The experimental difficulties in getting an accurate measure of the shape of the distribution curve rather restrict this method, so useful in principle, in providing a check on the mechanism inferred, not always unequivocally, from kinetic analysis.

While there is no doubt that in the polymers of vinyl derivatives the growing molecule is a free radical in some cases, as discussed in the article by C. C. Price, there is evidence that other types of active molecule exist. In the paper by Hulbert *et al.*, interesting speculations are made about the nature of the active molecule. With vinyl derivatives, however, it is not yet possible to draw up a summary showing how the velocity coefficient for polymer growth varies with the nature of the group attached to the vinyl group, and thereby probe deeper into the mechanism of polymerization.

The factors that govern the mechanical behaviour of high polymers are as yet only perceived with some difficulty, and no quantitative statements are possible. One method of tackling the problem is to take a given polymer and progressively modify the nature of the side-groups, simultaneously following the changes in physical properties. In this manner Baker and Fuller have prepared a series of polydecamethylene sebacamides using varying proportions of decamethylene diamine and 9-methyl nonamethylene diamine, and have examined the mechanical properties of stretched filaments, with simultaneous observations on structure by X-ray diffraction measurements. The straight-chain polyamide is rather brittle and easily crystallizes, whereas an increasing percentage of methyl groups destroys the regularity of the structure, diminishes the strength of hydrogen bonds and thus reduces lateral attraction between the chains. The 9-methyl polymer therefore exhibits rubber-like properties. Work of this kind serves to demonstrate forcibly that even relatively small changes in molecular architecture may lead to profound changes in mechanical properties. The accumulation of such systematic data will do more than anything else to help in establishing the general principles of a subject full of tremendous possibilities.

The statistical treatment of the theory of rubber elasticity resolved a problem which had seemed insoluble and provided additional support for the ideas concerning the structure of the rubber molecule. That theory initially assumed free rotation round carbon-carbon bonds. Evidence from other sources has accumulated to show that rotation is not free, though the potential barriers may often be as low as a few thousand calories. Florey and Rehner in their contribution to the discussion briefly examine the theory and conclude that the presence of low potential barriers does not lead to any important modification of the theory. They then report on some work from the same point of view on the vexed problem of the constitution of three-dimensional networks. Such polymers are by far the most difficult to investigate, for they cannot be got into solution; they merely swell to a gel, and X-ray methods, because of the impossibility of the existence of a high degree of order, do not yield a great deal of information. Florey and Rehner base their statistical theory on a three-dimensional model consisting of a tetrahedral unit in which four chains originate from the apices of the tetrahedron and meet in a point—the point of cross-linking—each tetrahedron containing one cross-link. In this way they derive a relationship between Young's modulus and parameters signifying the number of cross-links present in the polymer.

Between the extremes of perfect elastic behaviour, rubber elasticity and the viscous behaviour of a Newtonian liquid, there is a region of behaviour in which a great many high-polymer systems lie. Much effort has gone to try to develop a convincing and all-embracing theory, but it is obvious that the description of the behaviour of a substance which may possess, according to conditions, elements of all three components, is a matter which may well defy solution. It is, however, necessary to systematize data so far as possible, since such polymers are used for a variety of purposes where deformation, especially under the prolonged application of a stress, is a matter of the first importance. Simha and Ferry deal with this aspect of the problem, the former considering particularly the flow of high polymers and the latter very concentrated solutions. There is also an article by Huggins dealing with the thermodynamic properties of high-polymer solutions.

There is, unfortunately, no account of the discussion of the papers presented at the meeting. This does not detract from the interest and usefulness of the volume, but the printed record of a discussion often serves to clarify obscure points and settle conflicting opinions on such a controversial subject.

## PROBLEMS OF RACE

**Race and Rumors of Race**

Challenge to American Crisis. By Howard W. Odum. Pp. x+245. (Chapel Hill, N.C.: University of North Carolina Press; London: Oxford University Press, 1943.) 12*s*. net.

THE sins of the fathers are indeed being visited upon the children to the third, fourth and later generations in the southern States of the United States of America. Pressed by an uneasy conscience, the white South has tried here and there to reduce violence, to give somewhat better opportunities of education to the 'Negro', as he is called even if he often obviously has a good deal of white ancestry mixed in. But even those who want to treat the Negroes as brothers do not want them as brothers-in-law, and that is the root of the insoluble conflict. It is evident that recruitment and labour opportunities of the war-economy have given coloured folk a chance to escape from the old-time repression, and that it is becoming more and more difficult, in Africa as well as in the United States, to maintain a society in two layers without letting the lower one up anywhere. Both British and Americans are deeply concerned with the problems involved, and this book pictures for us what happens when the two layers talk about one another. The author gives a collection of fantastic rumours, many of which he helps us to see are quite baseless. But the rumour habit makes even the former limited inter-racial courtesies difficult to maintain; they are made to look like 'treason against your side', and this is inevitably the case, especially among the coloured folk.

The white South wants to be left alone, blames northern journalists, feels it must guard its traditions on behalf of its many brave sons fighting in far parts of the world, and, most of all, its girls whom those sons are likely to marry when they come back. But it cannot be left alone; coloured men in the armies of the United States will not come back to the old limitations. Inevitably the general level of education is still low among the children of the slaves, and the white South wants to protect its social standards and tradition of ease. But social standards are much more difficult to assess than are skin colour and hair type, and the protection of those standards is naturally enough made to include discrimination against, and segregation of, the coloured people. Several States have arrangements which in effect prevent Negroes from voting, and a number have laws making white-black marriages illegal; and Congress in 1944 is much concerned about some of these restrictions. Even were it possible to hand over a portion of the continent to the eleven million coloured people, that would not solve the problem as they would not have experience of either government or management.

The choice in these cases of bifid populations is ultimately between segregation and intermarriage, and segregation has hitherto meant anything but equality of opportunity for the coloured folk. They cannot be held down indefinitely, yet they have neither capital nor administrative experience. Meanwhile, the situation worsens and a world problem of racism on a larger scale than the Nazis talked about looms up, with only minor alleviations in sight.

H. J. FLEURE.

## A MEMOIR ON SOME BOLETACEÆ

**The Boletaceæ of North Carolina**

By Prof. William Chambers Coker and Alma Holland Beers. Pp. viii+96+66 plates. (Chapel Hill, N.C.: University of North Caroline Press; London: Oxford University Press, 1943.) 43*s*. net.

MYCOLOGY is in debt to the University of North Carolina for the monographs which have been published by its press in the past, and now a new one is added to the series. Because of the great range of fungal species, we might expect that a book on the Boletaceæ of North Carolina would be of considerable value to students of these fungi in Britain. However, this purely systematic account will be of little real help to British workers, since of the seventy or so species considered less than a quarter would seem to occur in Britain.

The book is well produced and sixty-seven species of Boletus, four of Boletinus and one of Strobilomyces are considered, twenty-one species being illustrated in colour. There are also photographs of most of the species in fifty-five full-page plates at the end of the book. It is doubtful how much these photographs will help in identification, and they are certainly no substitute for good coloured reproductions.

There are four plates illustrating the spores of all the species considered. A glance at these suggests that only in a very few species does the spore size and form offer much help in making an identification. However, this is a step in the right direction, as progress in the study of the systematics of toadstools lies in paying more attention to microscopic characters. By such attention we may hope that the identification of toadstools will become more of an exact science and less a question of lore handed on by one generation of field mycologists to the next.

C. T. INGOLD.

## Minerals in Industry

By W. R. Jones. (Pelican Books, A.123.) Pp. 149. (Harmondsworth and New York: Penguin Books, Ltd., 1944.) 9*d*. net.

THIS War, more than any other, has served, through the agency of the Press and the B.B.C., to bring home to the general public the importance to the belligerents of access to sources of minerals of all kinds. It is no doubt widely realized, too, that the question of mineral supplies will, or should, play an important part in international peace settlements, as well as in post-war trade.

"Minerals in Industry" provides in concise and very readable form all the information on the subject of economically important minerals likely to be required by general readers wishing to take an intelligent interest in such matters. The short introduction includes a brief account of the different modes of occurrence of ores and minerals. There follow, in alphabetical order, descriptions of a very wide variety of mineral substances and metallic ores, with notes on their uses in industry and the arts, together with particulars of the chief producing countries and world output. In a number of cases the average annual output from individual countries for the years immediately preceding the War is indicated diagrammatically; and there are outline world maps at the end of the book showing graphically the location of the sources of many of the more important minerals.

The inquiring reader can also glean from this little book why it is so important that a strict blockade of Germany, a country poor in mineral resources, should be maintained. He can further reconstruct for himself a picture of the disruption to the mineral supplies of Britain that resulted, not only from shipping shortage and submarine activities, but also through the spread of hostilities over Europe and into parts of Asia. How these difficulties have been met and overcome is a story that cannot be told until after the War.

Prof. Jones is to be congratulated on the addition of so excellent a book to the Pelican series.

V. A. EYLES.

## The Aborigines—'so-called'—and their Future

By Prof. G. S. Ghurye. (Gokhale Institute of Politics and Economics, Publication No. 11.) Pp. xvi+232. (Poona: Gokhale Institute of Politics and Economics, 1943.) 8 rupees; 16*s*.

PROF. G. S. GHURYE, head of the Department of Sociology in the University of Bombay, here examines the position of primitive tribes in India and the question of their administration. He goes into their position with reference to their classification by the Census of India separately from Hindus and other religious divisions, and into the question of their relationship with Hindus proper; he examines their treatment by the Government of India, and by the British Parliament; he examines the reports, and recommendations, which anthropologists have made in regard to them; and finally he states the problem which, in his opinion, the present condition of the hill and forest tribes presents.

Prof. Ghurye is a whole-hearted supporter of the assimilation of the Backward Tracts to the rest of India politically, and has made the best case he could for this view; though he seems to realize the problem involved in protecting the aboriginal tribesman from the chicanery of Indian money-lenders and land-grabbers, and from the complete unsuitability of proceedings in Indian law courts. He has made himself very thoroughly acquainted with the literature on the subject, but his treatment of authorities does not appear to be entirely disingenuous. Thus he quotes Hutton's statement that the tribesman who claims to be treated as a caste in order to improve his social position frequently succeeds in achieving greater degradation. He goes on to add that Hutton does not attempt to explain why. If he had read to the end of the paragraph he quotes, he would have seen that the explanation given is clear enough; it is that the caste acquired is so often treated as an untouchable one, whereas, so long as the tribesman remains non-Hindu, he is treated with a certain amount of comparative respect. This is an aspect of the problem which Prof. Ghurye has not followed up, though elsewhere he remarks that the Satnami and Kabirpanthi sects are available "for any tribe to take recourse to avoid the stigma of untouchability". Unfortunately, the Chamars and others who belong to those sects are not the less untouchable on that account. Other points on which Prof. Ghurye fails to deal convincingly with his material are his specious argument that infant marriage is preferable to pre-marital license, and his attempt to show that the aboriginal tribes who are on the face of it doubtfully Hindu are quite as much Hindus as many of the lower castes. This may be more or less true in the case of some tribes and some castes, but most certainly does not hold good of all. Prof. Ghurye, wisely for the establishment of his case, avoids dealing specifically with the tribes of Assam, letting their case go with the rest by supposed analogy.

The volume would have been improved by the addition of a proper bibliography of the works quoted, an index, and at least one map.

## Dictionary of Organic Compounds

The Constitution and Physical and Chemical Properties of the Principal Carbon Compounds and their Derivatives, together with the Relevant Literature References. Edited by Prof. I. M. Heilbron and H. M. Bunbury. Vol. 2: Eccaine—Myrtillin Chloride. Pp. viii+892. Vol. 3: Naphthacarbazole—Zygadenine. Pp. viii+978. (London: Eyre and Spottiswoode (Publishers), Ltd., 1943.) £6 6*s*. net each vol.

THESE two volumes complete the new edition. As indicated in a recent notice (NATURE, Nov 20, 1943, p. 586), they are reprints of the first edition with supplements containing data collected since the original publication of the work. The supplements comprise 42 pages in vol. 2 and 32 pages in vol. 3. The editors and publishers are to be congratulated on making available under very difficult conditions a new and complete issue of a substantial work of such value in organic chemistry and biochemistry. All practitioners of these rapidly expanding branches of science will hope that here is a dictionary which has come to stay and to keep in step with progress in these vast and complex fields of research. J. R.

## The Microbe Man

A Life of Pasteur for Children. By Eleanor Doorly. (Puffin Story Books, P.S.8.) Pp. 112. (Harmondsworth and New York: Penguin Books, Ltd., 1943.) 9*d*. net.

THIS is a short and pleasant account of the highlights in the life of Louis Pasteur, written for children in simple language. The illustrations, woodcuts by Robert Gibbings, are handsome, but irrelevant.

# DIAMONDS, NATURAL AND ARTIFICIAL*

By DR. KATHLEEN LONSDALE
Davy Faraday Laboratory, London

MANY people are interested in the diamond on account of its qualities as a jewel, its beauty and durability, or perhaps its value and portability. Others are chiefly concerned with its many industrial uses. To the geologist it is a fascinating mineral; the chemist regards it as the prototype of all the aliphatic compounds. But everyone must recognize it to be the aristocrat of the crystal world and must be interested to know why it attains such a high degree of perfection in so many of its properties. That question cannot yet be given a really adequate answer, for diamond still presents us with a very difficult problem. One point that needs to be emphasized is that each diamond is an individual; diamonds may look alike and yet behave very differently, with the result that it is dangerous, if not actively misleading, to generalize from observations, however accurate in themselves, which have been made on only one, or a few, specimens.

Consider the appearance of diamonds when illuminated by ultra-violet light. Some fluoresce brightly, others scarcely at all; with some the main fluorescence is blue, others are greenish, yellow, orange or pink. Crookes records that when diamonds are bombarded with cathode rays, they emit a light which may be bright-blue, pale-blue, apricot, red, orange, yellowish-green or pale-green. Such observations, even when made on many diamonds, although of considerable interest, are of little scientific value unless they can be correlated with other properties of the particular specimens observed. When placed in an X-ray beam, all the diamonds that I have observed fluoresced, if at all, with a greyish-blue colour, some more strongly than others. In most cases the luminescence ceased immediately the X-rays were cut off, but in others phosphorescence continued for several minutes and only died away gradually.

Or consider the colour of diamonds. Really clear-white diamonds are comparatively rare; most diamonds have a slight tinge of colour, and in many the colour is quite marked. But these colours are not necessarily stable; yellow diamonds are said to be comparatively difficult to change, but there are records of green stones which have become colourless, yellow or brown, when heated in an atmosphere of hydrogen; of black, brown and dark-green stones that have become violet. One colourless diamond heated in the absence of air became rose-coloured and retained this colour for several days in the dark, but the colour disappeared in sunlight, though it could be regained by reheating. On the other hand, a rose-coloured diamond became colourless when heated, but later regained its colour. Occasionally the colour is only skin-deep. Sometimes the colour changes are relatively uniform. Diamonds when strongly heated turn black, and when exposed to the $\alpha$-rays of radium they turn green, but revert to their original colour on heating.

The density of diamond has been variously given as ranging from 3·01 to 3·56 gm./c.c., yet the distance apart of the carbon atoms of which the crystal is composed varies by not more than about 1 in 7,000 from one specimen to another. The true density, corresponding to the structure, is 3·515 gm./c.c. The observed variation on the light side may be due to gas or liquid inclusions, to the presence of light foreign atoms such as hydrogen or boron, or to the fact that the diamond investigated is not a single crystal. The forms of industrial diamond known as boart, carbonado or ballas tend to be light simply because they are variously arranged aggregates of very small diamond crystallites, and no aggregate of crystallites can ever occupy as little space as a single crystal of the same weight. Variations of density on the heavy side must be due to the presence of heavy impurity. F. G. Chesley (1942), using thirty-three diamonds from different localities, found by means of spectroscopic examination that aluminium, silicon, calcium and magnesium were present in all of them. He detected also the occasional presence of nine other heavy elements; but, apart from what may have been chance coincidences, he was unable to correlate his observations with the colour, habit or fluorescence of the specimens used. By the method he adopted, however, he could not have detected the presence of hydrogen, boron, nitrogen, oxygen, phosphorus, sulphur or the halogens, some of which are very probable impurities.

There are many important properties, however, which all diamonds possess in common. They are all composed mainly of carbon atoms, arranged to give cubic symmetry. The structure, determined in 1913 by W. H. and W. L. Bragg, consists of two interpenetrating face-centred cubic patterns, separated from each other by a translation of a quarter of the cube diagonal. The side of the unit cell is $3559 \cdot 65 \pm 0 \cdot 25$ X.U. (a real variation), giving a C—C separation of $1541 \cdot 37 \pm 0 \cdot 11$ X.U., or nearly 1·5445 A. It is interesting to note that each carbon atom in the structure is surrounded tetrahedrally by four others. It appears that in diamond the four valencies of carbon must be tetrahedrally directed, a beautiful confirmation of the theory of van t'Hoff, who postulated such a tetrahedral arrangement in order to explain the existence of *d*- and *l*-isomers of organic compounds containing an asymmetric carbon atom. This theory was also the foundation of Pasteur's work on the optical activity of the tartaric acids. We find that this tetrahedral arrangement of the carbon atom valencies is preserved, at least approximately, in all the aliphatic compounds, such as the sugars, paraffins and fatty acids.

One consequence of the tetrahedral arrangement of valency bonds is that diamond is not nearly so dense as it would be if the carbon atoms were close-packed. If atoms 1·54 A. in diameter were built up into a *simple* face-centred cubic pattern, the density of the resulting structure would be 7·653 gm./c.c. instead of 3·515. It is clear, therefore, that the hardness of diamond, its resistance to abrasion, which is one of its most remarkable and useful features, is not due to its compactness; for it would, in fact, be possible to pack more than twice as many atoms into the space actually occupied by the carbon atoms of diamond. It is rather due to the fact that each atom is sharing electrons with all its four neighbours in such a way as to build up a system of great engineering stability, which may be regarded either as one large molecule or as a series of interlocking long-chain molecules of immense length. Figs. 1 and 2 illustrate the types of chains that are associated with the projections along the cube axis and face diagonal respectively. Each atom is common to four chains of each type.

* Afternoon lecture at the Royal Institution delivered on March 30.

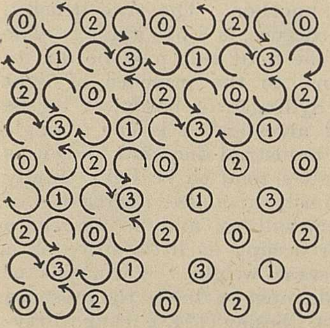


FIG. 1. INTERLOCKING SPIRALS SEEN IN PROJECTION ALONG CUBIC AXIS. 0, 1, 2, 3 ARE ON DIFFERENT LEVELS.

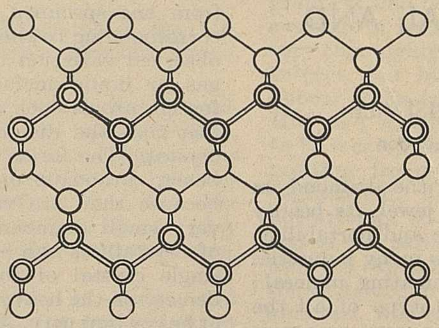


Fig. 2. INTERLOCKING ZIGZAG CHAINS (AS IN LONG-CHAIN PARAFFINS) AND CHAINS OF PUCKERED HEXAGONS (AS IN CONDENSED CYCLOHEXANE DERIVATIVES) SEEN IN PROJECTION ALONG A FACE DIAGONAL.

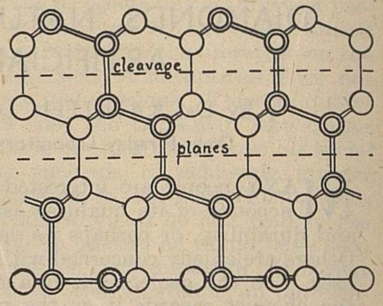



Fig. 3. ARRANGEMENT OF CARBON ATOMS IN OCTAHEDRAL PLANES (111), AND FORMATION OF PSEUDO-GRAPHITIC LAYER AT SURFACE OF DIAMONDS.

○, ATOMS IN PLANE OF PROJECTION. ◎, ATOMS ABOVE AND BELOW PLANE OF PROJECTION.

We may expect that the presence of all these almost infinitely long chains will give diamond, *par excellence*, the properties that we have learned to associate with the *length* direction of long-chain molecules. It is always found, for example, that the highest refractive index $\gamma$ in any organic crystal where the molecules are arranged in roughly parallel positions is associated with the longest dimension of the molecule, and that the longer the molecule, the higher the index. This property is used by crystallographers in order to help to determine the orientation of the molecules in unknown structures. We should expect, therefore, that the refractive index of diamond would be high; it is, in fact, higher than that of any other known substance, and it is because of this quality and because of its high dispersive power that diamond, when cut as a gem, not only flashes brilliantly, but also flashes with all the colours of the rainbow.

There are not so many accurate data for the heat conductivity in various directions in single crystals, but there are enough to show that the conductivity is a maximum in the direction of the chain-length for crystals of any kind of electronic constitution, and that it is greater for perfect than for imperfect crystals. We are not surprised, therefore, to find that the thermal conductivity of diamond is high, as a simple experiment will prove; it is higher than that of some metals and nearly 200 times that of glass. Dr. A. Müller has shown that the linear thermal expansion and compressibility of long-chain compounds are markedly less along the direction of their length than at right angles to that direction; and we may expect, therefore, that for diamond the linear coefficient of thermal expansion will be small (it is one tenth that of glass and one twentieth that of silver), while the bulk modulus, or resistance to compression, will be large.

| | Thermal conductivity | Linear coefficient of thermal expansion | Bulk modulus | Young's modulus |
|---|---|---|---|---|
| Diamond | 0·35 at 18° C. | $0 \cdot 9 \times 10^{-6}$ | $6 \cdot 0 \times 10^{12}$ | $5 \cdot 5 \times 10^{12}$ dynes/cm.² |
| Tungsten | 0·35 ,, | 4·3 ,, | 3·04 ,, | 3·91 ,, ,, |
| Steel | 0·11 ,, | 11·0 ,, | 1·6 ,, | 2·2 ,, ,, |
| Silver | 1·00 ,, | 18·8 ,, | 1·0 ,, | 0·75 ,, ,, |
| Glass | 0·002 ,, | 9·0 ,, | 0·5 ,, | 0·7 ,, ,, |

These properties are, of course, related to the toughness of diamond in wear, to the ability with which it will stand up to large pressures and to big and sudden changes of temperature, and therefore to its usefulness for industrial purposes. The forces of cohesion are not the same in all directions; the very fact that diamonds usually grow as octahedra shows that, in the process of growth, atoms can be attached most easily in the direction of the cube axes and least readily along the body diagonals of the cube. Conversely, solution effects have shown very spectacularly that atoms are most easily detached along the cube directions, and in the same way diamond dies, after prolonged use, show signs of wear which is definitely a function of direction; while it is a matter of common experience that diamonds cannot be polished along the 'grain' of their octahedral faces. The cleavage on the octahedral planes constitutes a point of weakness; diamond dies often give way by fracture along a cleavage plane, and when diamonds 'burst' spontaneously, as they sometimes do*, it is also by octahedral rupture. Compared with that of many other crystals, however, the cleavage of diamond is difficult, because valency bonds have to be broken (Fig. 3); whereas in graphite, for example, the forces between successive atomic layers are so weak that slipping can easily occur. Hence the use of graphite as a lubricant. Diamonds, however, are also very slippery crystals to handle; and it is possible that the electron orbits in the surface atoms may easily assume a pseudo-graphitic configuration, a hypothesis that would help to explain why diamonds can be electrified by rubbing.

Some properties of diamond, therefore, differ widely from one specimen to another, while other properties are shared in common by all. Let us now consider those respects in which diamonds seem to divide themselves into two types, well-defined although not altogether clear-cut. About ten years ago, Sir Robert Robertson and Drs. J. J. Fox and A. E. Martin found that whereas most diamonds showed an absorption band at 8 $\mu$ (1,288 cm.$^{-1}$), six out of three hundred specimens did not. In the ultra-violet region a similar difference existed; the same six diamonds were transparent as far as 2250 $\lambda$, although most diamonds are opaque to radiation beyond 3000 $\lambda$. Later investigation on large numbers of diamonds from South Africa and India has shown that the 'transparent' diamonds are rare, but occasionally—such are the vagaries of the diamond—very small collections have proved to be all, or nearly all, of this rare type. Chesley found one 'transparent' diamond among those that he tested and it happened to be the purest of them all, but it would be most unwise to generalize from this one observation. The dangers of generalizing

* Two such specimens, lent by Prof. W. T. Gordon, were shown.

even from a number of observations are illustrated by the fact that Robertson and his colleagues found that most type I (opaque) diamonds were optically anisotropic, presumably owing to strain, but that the six type II (transparent) diamonds were nearly isotropic; Sir C. V. Raman, on the other hand, has found that type II diamonds sometimes show considerable restoration of light between crossed nicols, while many type I diamonds are isotropic. Most observers agree that type II diamonds tend to show a fine lamellar structure, and Prof. E. N. da C. Andrade and Dr. Martindale found that minute silver crystals would grow at random on the surface of a type I diamond, but along parallel (straight or curved) lines on a type II specimen. Scarcely sufficient crystals were examined, however, to be certain that this behaviour is characteristic.

About four years ago, Sir C. V. Raman directed attention to some anomalous spots and streaks associated with the X-ray reflexions from the octahedral planes of diamond, these being easily observable on Laue photographs taken in certain orientations. This phenomenon was investigated in great detail at the Davy Faraday Laboratory, and similar effects were found in association with other reflexions also, but no theory was found that would satisfactorily explain *all* the facts; nor is such a theory yet available. A suggestion by Sir Robert Robertson that it would be of interest to examine the Laue photographs given by both types of diamond was taken up, with most interesting results. It was found that whereas all type I diamonds gave the anomalous streaks with more or less intensity, type II diamonds showed no trace of them at all, nor of the other anomalous non-Laue effects observed in other orientations, although *all* diamonds gave extra spots due to thermal vibration of the atoms. The diamonds tested included several of those originally examined by Robertson *et al.*, as well as many others found to be either 'opaque' or 'transparent' in the ultraviolet. It was found, moreover, that type II diamonds were much better reflectors of X-rays than type I. A further difference was found in divergent-beam X-ray photographs, for type II diamonds always gave a clear, sharply contrasted pattern of absorption and reflexion lines, whereas the best type I diamonds gave a foggy picture on which few, if any, lines could be seen at all. These later observations definitely prove that type I diamonds are, generally speaking, 'perfect' in structure, but that type II diamonds are 'mosaic', that is, composed of small crystallites not quite regularly arranged. This fact, however, does not explain all the observed differences between the two types of diamond (which are tabulated below), although it does explain some of them. There is *no* difference in C—C spacing, Raman frequency, or specific heats at low temperatures.

DIFFERENCES BETWEEN TYPE I AND TYPE II DIAMONDS

| Type I (relatively perfect) | Type II (mosaic) |
|---|---|
| (1) Common. | (1) Rare, in general. |
| (2) Infra-red: absorbs at 8 $\mu$. | (2) Infra-red: transparent at 8 $\mu$. |
| (3) Ultra-violet: absorbs beyond 3000 $\lambda$. | (3) Ultra-violet: transparent to 2250 $\lambda$. |
| (4) Often perfect octahedra, with perfect surface. | (4) Often lamellated. |
| (5) Give streaks and triangles on Laue photographs. | (5) No streaks or triangles on Laue photographs. |
| (6) Reflexions of moderate intensity. | (6) Reflexions very intense. |
| (7) Poor divergent-beam photographs. | (7) Excellent divergent-beam photographs. |
| (8) Slight photoconductivity. | (8) Marked photoconductivity. |

A consideration of growth phenomena in crystals generally shows us that, in order to obtain 'perfect' crystals, slow and uniform variation of conditions is necessary; slow, regular evaporation or fall of temperature, for example. 'Mosaic' crystals are formed when growth is more rapid or irregular. Although the problem as to how diamonds were formed in Nature is still unsolved, it seems fairly certain that their growth was slow. Diamonds are mined from pipes of igneous origin, where they are found in the 'blue ground', kimberlite; but they almost certainly did not originate there. They are also found in alluvial deposits in river beds, and they have been thrown down from the skies in meteorites. Some of the earth-formed diamonds are not only huge (the Cullinan, which weighed nearly 1 lb. 6 oz., was obviously only part of a still larger diamond) but also practically perfect crystals, from which many superb gems can be cut. Scientific workers are not usually interested in crown jewels or even tiaras, but they would like to be able to make diamonds under controlled conditions. Rubies, sapphires, chrysoberyls, spinels and other gem materials can be made in the laboratory; why not diamond? The main answer is, of course, that in spite of its hardness and inactivity, diamond is not the most stable form of crystalline carbon, at least under ordinary temperatures and pressures. A great many attempts were made in the nineteenth century to find conditions under which carbon could be made to crystallize as diamond rather than as the more stable form, graphite. Moisson's well-known attempts to crystallize pure carbon from solution in iron or silver were believed by many, including Sir William Crookes, to have been successful, but none of his specimens remain. Sir Charles Parsons tried to melt carbon by the imposition of enormous instantaneous pressure and temperature, and also by means of hydraulic pressure and electrical heating; he tried to repeat and improve not only Moisson's method, but also the methods of all previous workers who had claimed any measure of success; and he tried other new methods; but towards the end of his life he and his assistant, Mr. Duncan, became convinced that neither they nor anyone else had ever succeeded in making diamond in the laboratory.

Meanwhile there were, in the possession of the Mineral Department of the British Museum, twelve minute crystals on a glass slide, labelled as being diamond, artificially prepared and presented by J. B. Hannay in 1880. These were presumably the remains of those tested and pronounced to be genuine diamond by Prof. Story-Maskelyne, the keeper of minerals at that time. Hannay's method was to take a mixture of 'paraffin spirit', bone oil and solid lithium, place it in a wrought iron tube which was then closed by welding, heat the tube in a reverberatory furnace for fourteen hours at a dull red heat and then, if it had not exploded, allow it to cool slowly. It was usually found that the iron had become porous on heating and had not held the pressure; but in three experiments out of eighty, the pressure *was* held in some way, for on opening the tube there was a rush of gas given off. A hard smooth mass which was found adhering to the inside of the upper end of the tube was crushed and some hard transparent crystals were found, some of which were tested by Hannay and some of which were sent to the British Museum for Prof. Story-Maskelyne to test. The report of Hannay's success was greeted by the scientific world of his day first with acclamation, then with incredulity and finally with suspicion. It was thought that a practical joke may have been played upon him by an assistant, but according to Sir James French, who as a boy knew Hannay and who remembers the circumstances of the experiment, Hannay was well aware of this possibility and guarded against it. Hannay repeated the experiments a year later, using various tube linings; and he claimed success in four out of thirty-four experiments at this later stage. Other scientific workers accepted the experiment as genuine but believed that the crystals obtained were a carbon-rich form of carborundum, which is not unlike diamond in structure, appearance and properties. So late as 1902 Hannay indignantly refuted this suggestion, which had been made in the "Encyclopædia Britannica" of that date. An X-ray investigation of the twelve crystals preserved at the British Museum has proved definitely that eleven of them are diamonds; many of them show striations similar to those found on type II diamonds, and a special investigation of one specimen has proved that it is, in fact, a type II diamond. In spite of its minute size (less than 0·05 mgm. or 0·00025 carat) it is an excellent reflector, but it shows no signs of the type I streaks or triangles, although it shows the 'thermal spot' common to all diamonds. Although type II diamonds are comparatively rare in Nature, it is this mosaic type that one would expect to be formed under the relatively hurried conditions of a laboratory experiment. We can prove that the crystals are diamonds, but we cannot prove that Hannay made them. All things being considered, however, it seems only right to assume that he did; the matter was discussed at length in the correspondence columns of NATURE in 1943.

In some ways the problem of diamond is like a crossword puzzle. We have clues, but in some cases we do not know the solution; in other cases there seem to be more than one possible solution. But as Sir William Bragg said many years ago: "There is no cross-word puzzle that can compare in interest with the practical working out of a problem in Physics or Chemistry. You may say that to work at an amusing thing is not a very noble task. I can only answer that it makes a very happy life and I think that, if we can increase the number of human beings who find happiness in their work, we shall have gone some way towards creating a better state of things."

# CHUNGKING INDUSTRIAL AND MINING EXHIBITION

By DR. JOSEPH NEEDHAM, F.R.S.
British Scientific Mission in China

DURING March an important Exhibition of Technology organized by the National Resources Commission (part of the Chinese Government's Ministry of Economic Affairs) was held in Chungking. This exhibition, which has attracted daily many thousands of visitors, deserves a world attention wider than the interest of the inhabitants of the Chinese capital, since it signalizes in a striking way the determination of China to embark upon large-scale industrialization, by which alone the standard of life of the masses in China can be permanently raised.

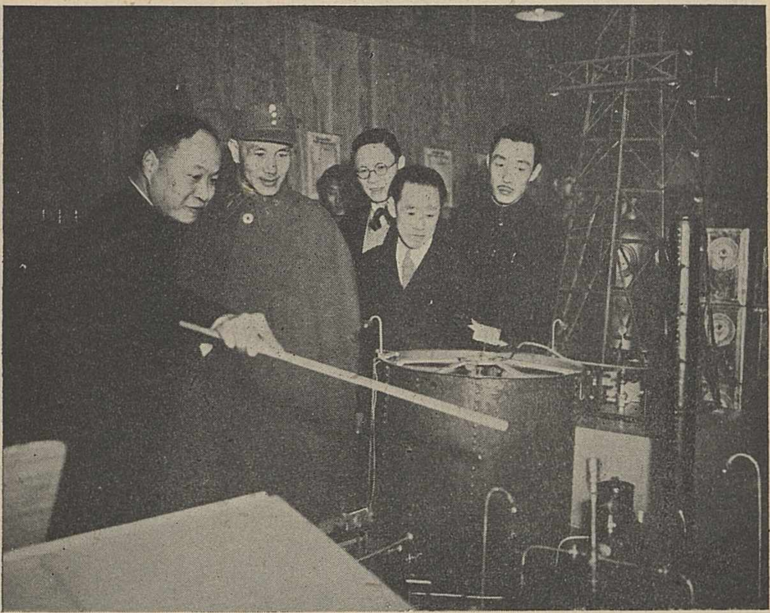
The exhibition occupied large and spacious halls, specially constructed for the occasion entirely of bamboo poles and matting, and set up on the campus of the Chiuching Middle School in pleasant surroundings. Facing the visitor in the imposing entrance-hall were the devices (acting as badges stimulating *esprit de corps*, as well as trade-marks) of the 105 mines and industrial plants operated by the National Resources Commission in Free China, that is, in the south-east, south-west and north-west parts of the country. The Commission employs some 170,000 workers, part of whom are skilled, and 12,000 staff, of whom some 42 per cent are trained engineers, chemists, etc., and 23 per cent in the administrative division. The walls of the entrance-hall were covered with maps and charts, and below were displayed a remarkable collection of mineral geological specimens, arranged with the aid of the Chinese Geological Survey. Here it may be observed that China produces 70 per cent of the world's antimony. Here one could handle a specimen of the ponderous tungsten ore, wolframite, of which China is the leading world producer. In the centre of the hall was an exhibit which should have been very educational for the Chinese public—a display of all the old provincial weights and measures side by side with the standard measures of weight and capacity. The importance of standardization was also shown by a medley of pieces of electric equipment, none of which will fit each other, presumably the result of pre-war purchases from Western countries, and showing the necessity of one standardized industry for all China. An idea of what standardization means was also given by a well-arranged exhibit of gun parts supplied by the arsenals of the Chinese Ordnance Administration.

## Mining and Metallurgy

Proceeding along his fixed path, the visitor came next to the section on coal and oil. Here there were excellent stratigraphic mine models, pictures of types of transport, and a historical series showing the evolution of the miner's lamp in China from the Roman-style oil wick to the modern battery light. In the oilfield section, there was a magnificent model of the Kansu field in its desert mountains, and a number of working models not only of drilling derricks (about 6 ft. high) but also of the refinery. There were also actual specimens of the drilling bits and jigs, and a display of the various refinery products.

After this, the visitor reached the iron and steel section. There was a short historical exhibit going back to ancient Egyptian iron technology, and ending with modern metallographic pictures. The model blast furnaces were particularly fine, standing about 10 ft. from the ground and complete in every detail. One in particular was of interest as the original was largely built out of steel plate salvaged from river-steamers destroyed by bombing.

The metallurgical department continued into the non-ferrous metals section, which was particularly good. The display of specimens of economic minerals in the entrance hall, to which reference has already been made, was repeated on a smaller scale in each of the non-ferrous and mining halls; a very fine educational idea, since anyone who failed to take in the full import of the various minerals when he first saw them, could turn aside from the metallurgical models and familiarize himself with the ores on which the industries are based. Interesting copper-aluminium alloys with properties similar to nichrome steel were shown by the Electrochemical and Metallurgical



GENERALISSIMO CHIANG KAI-SHEK INSPECTING THE OIL-FIELD EXHIBIT. LEFT TO RIGHT: DR. SUN YU-CHI, GENERAL MANAGER OF THE KANSU PETROLEUM ADMINISTRATION; GENERALISSIMO CHIANG KAI-SHEK; DR. CHIEN CHANG-CHAO, VICE-CHAIRMAN OF THE NATIONAL RESOURCES COMMISSION; DR. WONG WEN-HAO, MINISTER OF ECONOMIC AFFAIRS AND CHAIRMAN OF THE NATIONAL RESOURCES COMMISSION.

Works at Sanchi under the direction of Dr. Yeh Chu-Pei (Yap Chu-Phay). This same works recovers zinc and copper from the bronze coins of former dynasties, of which a large stock has been collected, as well as smelting the native ores. It also produces copper of ordnance standard by electrolytic purification, of which an excellent working model was shown. Bauxite has now been discovered in Yunnan and Kweichow provinces, and an ingot of aluminium bears the triumphant inscription "The first Al sample industrially produced in China, at 4.30 p.m. on Dec. 11th, 1943". The sump mining of cassiterite tin ore was illustrated by an excellent timber model showing the washing troughs, and there was a working model of a tin smelting and purification plant. In the washing of wolframite ancient traditional wooden implements are used, also shown in model form. Particularly interesting is the technology of mercury. There were beautiful specimens of cinnabar, that precious substance of the early Chinese alchemists, and a series of models illustrated the different types of traditional smelting furnaces used in the different provinces. Finally, the antimony industry showed antimony ingots and models of paint-production plants.

Leaving the metallurgical section, one entered that of the refractories, where a large variety of heat-resistant bricks and acid-resistant stoneware was shown. There was a good display of China-made Seger cones.

## Chemical Industry

Next came the chemical industry. The production of power alcohol, so wisely encouraged as a contribution to blockaded China's supply of transportation fuel, was represented by a fine series of models, notably that from Dr. Chang Chi-Hsi's plant, and good exhibits, both on the chemical and the mycological sides. The production of petrol by cracking vegetable oils, the other main contribution to the fuel supply, was illustrated by a working model of a pipe-still, cracking chamber, and fractionating column, made entirely of glass, from the Tungli works (Dr. Hsu Ming-Tsai and Dr. Sun Tsun-Chueh). On an adjacent stand, surrounding a young tung oil tree, were shown all the products which may be (and, in most cases, are being) made from the oil, such as candles, margarine, vanishing cream, paint, varnishes, printing inks, solvents, lubricating oils, plastics, kerosene, petrol, Diesel oil, tar, and even oil-resistant synthetic rubber (through ethylene to thiokol). When tung oil petrol is no longer needed after the War, it should still be possible to base a great industry on the tung oil plantations.

## Engineering

The electrical industry exhibits were arranged around a circular domed hall, indirectly lit, and with grass and herbs strewn on the ground. Music for the whole exhibition was provided by Chinese-made radio gramophones in the radio section. Among the great variety of apparatus shown in the hall one noticed aviation ground-station equipment transmitters of 20–100 m. frequency range (input 2 kW. : output ½ kW.); short-wave broadcasting transmitters for interprovincial communications (input 4 kW. : output 1 kW.); scrambler sets; radio beacon transmitters; military walkie-talkie sets with bamboo aerials; hand and 1-h.p. motor generators; 5-tube superhet receivers; 8- and 10-tube communications receivers (pronounced by an expert to be as good as any in the world); universal meters for currents and resistances; 50-watt public address system amplifiers; a very large assortment of radio valves; telephone exchanges with the receivers of lacquered wood owing to the plastics shortage; motors and switchgear; and intercommunication telephones. On an average, 88·3 per cent of the component parts of all this apparatus was made entirely in China; only in the case of some valves and meters are the Chinese still dependent on imports from abroad. They hope to raise the figure to 97 per cent this year. Besides all this apparatus, there was a wealth of wire and cables of all sizes, electric bulbs, dry cells and batteries, telegraph insulators and high-tension devices, silk- and rubber-covered flex, large accumulators made of wood and covered on the inside with an acid-resistant tung oil paint. One very educative exhibit was an illuminated circuit-diagram of a radio set actually working, and another was a flowsheet with all the component parts and their method of manufacture inserted. The biggest piece of Chinese-made apparatus in this section was a 1,200 kVA. step-up transformer for use in a phosphorus factory. Very good porcelain lamp sockets and switches of simple design replace plastic ones.

No less impressive than the preceding sections was that devoted to hydraulic power. The existing and planned power grids were shown on very clear maps, and there were a number of beautiful topographic running-water models which strikingly explain how various natural features in river flow can be made


ENTRANCE HALL, WITH GEOLOGICAL MAPS AND COLLECTIONS IN THE BACKGROUND AND THE STANDARDIZATION EXHIBIT IN THE FOREGROUND.

use of. Thus the Changshou plant has no dam, but a mill-race channel some 2 km. long, partly roofed as protection against land-slides, and leading to a penstock of 43 ft. fall. At Wanhsien, on the other hand, there is a low dam on top of a natural rock waterfall, and a rock-cut tunnel giving a fall of 45 ft. and an output of 300 kW. At Shanyuting the mill-race channel is carried over a side-stream by a viaduct before it reaches the penstocks, and gives rise to 1,500 kW. At Taohuachi the tunnel cuts across the short side of an isosceles triangle made by the river, short-circuiting several natural falls, and achieving a penstock fall of 270 ft. giving 900 kW. Some idea of the planned capacity of these west China networks may be gained from the following figures :

| | |
|---|---|
| East Szechuan .. .. | 647,000 kW. |
| West Szechuan .. .. | 700,000 |
| Kweiyang (Kweichow) .. | 90,000 |
| Kunming (Yunnan) .. .. | 50,000 |
| Djenbei .. .. .. | 175,000 |
| Hsiangchung .. .. .. | 370,000 |
| Ohsi .. .. .. .. | 320,000 |
| Hsibei (Kansu) .. .. | 40,000 |

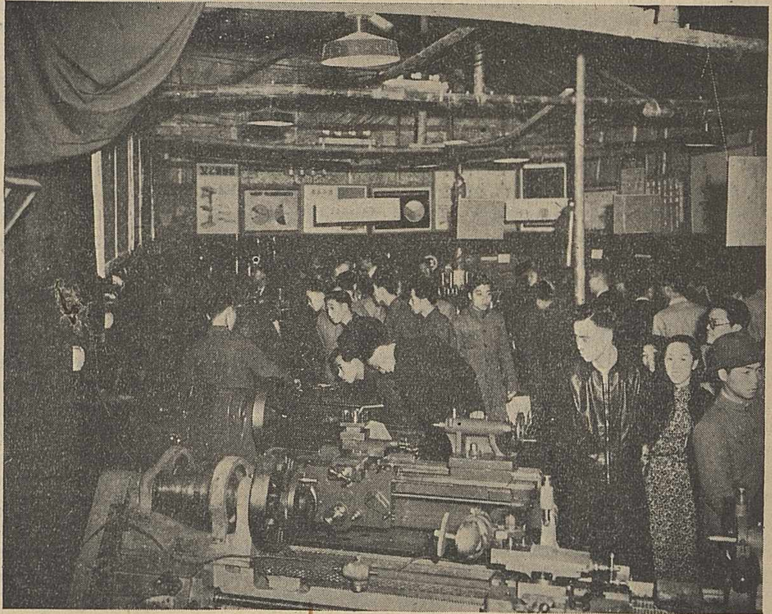
Not without interest, too, were the models of the high-tension line methods employed, the pylons being constructed mainly of wood.

The last section was that of mechanical engineering, showing the products of the different machine works. One saw first three models of power plants manufactured in China recently, namely, one 2,000 kW. boiler plant and two 150 h.p. water turbine and generator sets. On the other side were exhibited an actual six-cylinder stationary Diesel engine and generator set of 300 h.p. and one 10 h.p. gas engine set. Next in line came the various types of industrial machinery and motor-vehicle parts and also a set of village cotton-spinning machinery. The farthest corner contained the exhibit of precision tools and machine tools. The former included many items in common use such as lathe and drill chucks, gear cutters and hobs, micrometers and surface plates, while the latter included bench motor drills, drill presses, lathes, shapers and milling machines. Many of the items exhibited in this section were produced by China's biggest machine works, that at Kunming, directed by Dr. Wang Shou-Chin.

Throughout the exhibition the visitor noticed from time to time interesting photographs showing the welfare for the personnel (hospitals, schools, pithead baths, and the like) undertaken by the various plants. In this respect, the National Resources Commission stands as a striking example to private firms in Chinese mining and industry, where the workers' conditions are sometimes still in a distinctly backward state. Those who, like the present writer, have had the privilege of visiting many of the plants under the National Resources Commission, know that these pictures are no mere propaganda, but do actually represent the facts.

## The Future

A Western man of science came away from the Exhibition with two main impressions. In the first place, from what has been said above, it is clear that under the vigorous direction of Dr. Wong Wên-Hao, Minister of Economic Affairs and chairman of the National Resources Commission, and Dr. Chien Chang-Chao, vice-chairman of the Commission, the Chinese people have now the embryo (and by no means at a very early stage) of a Science Museum on



SECTION OF MECHANICAL ENGINEERING.

the lines of South Kensington. It would be a disaster if all these models and collections, now so carefully assembled, were to be dispersed or lost, and all those interested in science and technology in other lands will agree with me in hoping that some arrangements will be made for preserving the present exhibition as a germ of a Chinese National Museum of Science and Technology. I am informed, indeed, that it is likely that some such arrangements, in conjunction with the Ministry of Education, will be made.

The second, and more far-reaching, point is, of course, that the Exhibition demonstrates, once and for all, that given the tools of the trade, Chinese technologists, engineers and scientific men are the equal of any in the world. To me, not unfamiliar with them beforehand, this came as no surprise, but it is a point which ought to be brought home to all those in Western countries who are concerned with post-war trade relations with China. Any idea that the Chinese are personally unfitted for technology and industry is a complete illusion. Any idea that they do not wish to industrialize their great country and will for ever be content to accept the industrial products of other countries is also a fatal mistake. They deserve, and should receive, every help in their industrialization. It was interesting to hear the comment of a Western diplomat who had spent many years in Japan, that in spite of the much-vaunted industrialization of that country, he had never seen there so well-arranged a technological exhibition.

At the present time, Chinese science and technology are encountering formidable obstacles. There is the state of blockade, which prevents the importation of essential apparatus if of any considerable weight; and there are the difficulties of transportation within the country, which lead to serious bottlenecks in raw material supplies; but worst of all is the financial situation, which renders all book-keeping so difficult and impedes all attempts, not only to attain all-out production, but even to reach the capacity production of the plants which have been set up with so much pain, trouble and technical skill. It seems that some urgent economic assistance is needed in this direction. Officials of the National Resources Commission say modestly that their efforts have been directed mainly to training cadres of technical men, a policy which will naturally bear fruit after the War rather than now. Nevertheless, her allies ought to find some way of aiding China to attain an all-out industrial production such as they themselves are able to carry on in the war against the Axis.

But in general, the point to be emphasized is that the Exhibition was a triumphant vindication of the technical excellence and competence of Chinese scientific and industrial workers. As such the world should take note of it. Not that the Chinese are late-comers to the world of industry. Their ancestors were using ploughs of iron when ours were using wooden ones, they printed long before Guthenberg, knew of gunpowder long before Schwarz, and made porcelain long before Pallissy. But until modern, theoretical science was born, all such achievements remained purely empirical; and modern industrialization is not, and could never have been, based on purely empirical knowledge. The Chinese, therefore, have to master applied science as a whole, just as Westerners have done. The recent Exhibition showed that they are, what John of Monte Corvino called them four hundred years ago, "di nostra qualitá".

# J. B. VAN HELMONT (1579-1644)

By DR. W. PAGEL

JEAN BAPTISTE VAN HELMONT, the great Flemish natural philosopher, died three hundred years ago, at the age of sixty-five, bringing to a close a life embittered by religious persecution, but rich in inward contentment derived from sincere piety and a magnificent record of discoveries and ingenious conceptions in science and medicine. He devised one of the early thermometers. He proposed a reform of time measurement by the use of the pendulum and devoted much work to the investigation of its laws. He endeavoured to express vital phenomena in chemical terms and thereby became one of the founders of biochemistry. He demonstrated that acid is associated with digestion in the stomach and alkali in the duodenum. He was one of the initiators of modern pathology, which he sought to base on a study of the external agents in relation to local changes in the organs in disease. This led him to a refutation of the "Folly of Catarrh"—the title he gave to one of his treatises—for it was then believed that many diseases were due to a flow of mucus from the brain straight through the base of the skull to all parts of the body, notably to the lungs and joints, causing consumption, rheumatism, pneumonia, gout. He even made practical contributions to clinical medicine, for he examined the specific gravity of urine and demonstrated the presence of carbon dioxide and ferrous oxide in the waters of Spa by means of evaporation.

In connexion with the discovery of 'acid fermentation' in the stomach, it is worth while recalling the theories of Paracelsus (1493–1541), which admittedly stimulated Van Helmont's work. Paracelsus recognized different digestive properties in the various digestive organs, such as mouth and stomach ("Opus Paramirum", III), and described the powerful support of gastric digestion by intake of acid, notably those found in spas[1], but did not regard acid as a normal secretion of the stomach, except in the case of the ostrich, which is thus able to digest metals. The 'fermenting' action of acid, for example, in food, had already been mentioned by Galen[2], but up to Van Helmont's time and for a long time after, 'heat' and 'trituration' were believed to be the actual forces of digestion in the stomach.

Critical evidence has been given[3] of Van Helmont's achievements in chemistry, of the quantitative character of his work, of his extensive use of the balance. These gave him insight into the indestructibility of matter. Thus he showed, for example, that metals are recoverable without loss of weight after solution in acid. He realized, moreover, that when one metal precipitates another from a solution of a salt there is no transmutation. He also made a clear distinction between copper and iron vitriols[4].

Van Helmont studied volatile bodies with particular care. The achievement by which he is specially remembered is the separation from air and water vapour of a "New Entity" which he called "Gas". This "new entity" involved a change in the general concepts of biology, of medicine and indeed of cosmology and philosophy[5]. Such implications emerge with any attempt to restore the original setting in which the discovery was presented.

'Gas' appears first of all to be something 'specific' to the object in which it was contained. It is thus in contrast to volatile bodies such as air and water vapour, of which all objects in Nature may partake[6]. Van Helmont sees gas as the vector of a specificity which he believed he demonstrated in every being. Moreover, it is by virtue of its specific "gas" that an object is alive. "Life" in this sense means what later Glisson, carrying Van Helmont's conception a step further, called the "Energetic Nature of Substance". This was the point of view of Leibniz's monadology. Van Helmont, Glisson and Leibniz believed in 'forces' intrinsic *in* matter and its finest particles, but not acting *on* it. Thus the unsatisfactory dualism of 'soul' and 'body' was replaced by the idea of specifically different 'biological units' with spiritual and corporeal aspects. This was a kind of 'pluralism' which foreshadows certain modern biological concepts.

Each of these thinkers based his theories on certain scientific experiences of the day. Leibniz had in mind the innumerable organized units which the microscope had revealed in drops of water. Glisson had experience of tissue fibres and visualized intrinsic 'perception and appetite' in their fine anatomical organization, their irritability and formation of sphincters. It is no accident that it was he who discovered the rhythmic entry of bile into the duodenum and the sphincter at the orifice of the common bile duct. Van Helmont regarded the qualitatively different volatile products which he studied as the essence of various objects in Nature from which they were obtained. 'Gas' represented 'disposed' or 'organised matter' in the widest sense. Hence 'gas' as a chemical entity cannot be separated in his writings from its philosophical connotation. This is the stumbling block in his writings for most modern scientific readers. The inseparability of scientific result and philosophical implication applies to his achievements in physiology, pathology and his biological concept of time[7].

Such philosophical implications cannot be ignored in the works of seventeenth century scientific workers. Science was not yet an organized body of specialized subjects associated with the activities of full-time research workers and lecturers engaged in specially directed studies. Its status was, therefore, quite different from that which it came to assume in the following centuries. Nature as a whole, *Philosophia Naturalis* rather than a number of scientific subjects, presented itself to the scientific worker. His activities were bound to cover a much wider field and to be mingled with philosophical elements. It could not be taken for granted that the results of any particular worker were purely scientific or scientific at all, since there was no separation of philosophy and science, of belief and knowledge; though such a separation is the elementary premise of the scientific worker of the nineteenth and twentieth century. In discussing a writer of the time of Van Helmont, it is impossible to avoid discussing the original—philosophical—meaning of concepts which have now become exclusively scientific. "L'Historien des Sciences doit se faire le Contemporain des Savants dont il parle[8]." The case of Van Helmont is no isolated example of this claim.


[1] "Acetosum Esurinum." De morb. tartar., cap. 16.
[2] "De simpl. medicam temp.", I, 39; ed. Kuehn. **11**, 453.
[3] Partington, J. R., "Jean Baptista Van Helmont", *Annals of Science*, **1**, 359 (1936).
[4] Partington, *loc. cit.*, p. 368.
[5] Pagel, W., "The Religious and Philosophical Aspects of Van Helmont's Science and Medicine", *Supp. Bull. Hist. Med.*, No. 2 (Baltimore, 1944).
[6] Partington, *loc. cit.*, p. 373, lists fifteen kinds of gas described by Van Helmont and rightly emphasizes the qualitative differences which Van Helmont ascribed to them.
[8] Pagel, W., "Van Helmont De Tempore and the History of the Biological Concept of Time", *Isis*, **33**, 621 (1942).
[7] Metzger, H., "L'Historien des Sciences doit-il se faire le contemporain des savants dont il parle ?" *Archeion*, **15**, 34 (1933).


# OBITUARIES

## Mr. Frederick Chapman

THE sudden death of Frederick Chapman, a prominent authority on the Foraminifera and a distinguished Australian palæontologist, at his home at Kew, Victoria, on December 10, 1943, within a few weeks of his eightieth birthday, severs almost the last link in the chain of workers who for nearly a century have kept Britain in the forefront of the study of the Foraminifera.

Chapman was born at Camden Town, London, his father being Robert Chapman, who was assistant to Michael Faraday and John Tyndall. At an early age, through the influence of his brother Robert, he became interested in entomology and botany, but his appointment at the age of eighteen as laboratory assistant to Prof. J. W. Judd at the Royal College of Science led to his taking up geology as his life's work. He remained at the Royal College of Science until 1902, when, on the recommendation of Judd, he was appointed palæontologist to the National Museum, Melbourne. He occupied this position until 1927, when he was engaged by the Commonwealth Government as first Commonwealth palæontologist. He retired from his official duties in 1935, but continued to engage in scientific work until his death. From 1920 until 1932 he was part-time lecturer in palæontology at the University of Melbourne. He also occupied a number of honorary positions and served as a member of the International Commission on Zoological Nomenclature for more than twenty years.

Throughout his life, Chapman possessed good health and abundant energy as well as an absorbing interest in his work, and his scientific output was exceptionally large, comprising more than five hundred books and papers. While he had a special interest in the Foraminifera, on which he covered a wider field than any other writer on the group, his publications deal with geology, palæontology and zoology. Of these may be mentioned his papers, "The Foraminifera of the Gault of Folkestone", "New or Little Known Fossils in the National Museum", his reports on the Foraminifera and Ostracoda of the Shackleton and Mawson Expeditions to the Antarctic, and his books, "The Foraminifera", "Australasian Fossils", and "Open Air Studies in Australia". It has been said that in his work in Australia he attempted too much; but, as Prof. J. W. Gregory remarked when Chapman was awarded the Lyell Medal of the Geological Society of London in 1930, "A man single-handed, in charge of a great palæontological collection, cannot however specialize. He has to do what comes to him and not what he would choose. Mr. Chapman loyally and valiantly dealt with an unusually wide range of fossils . . ." Chapman's last work was a paper dealing with the conclusion of the investigation, begun by him nearly fifty years before, of the cores from the borings put down at Funafuti by the Royal Society of London to test the correctness of Charles Darwin's theory of the formation of coral reefs. This is still unpublished.

Chapman's great services to science were recognized by his election as an associate of the Linnean Society of London (1896), the honorary fellowship of the Royal Microscopical Society (1929), the award of the Lyell Fund (1899) and the Lyell Medal (1930) of the Geological Society of London, and other distinctions conferred on him in Australia, New Zealand and the United States. One of the finest tributes to his work

*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.*

## SUNDERLAND EDUCATION COMMITTEE

THE TECHNICAL COLLEGE

Principal:
F. H. Reid, B.Sc., Wh.Ex., M.I.Mech.E.

Applications are invited for the post of HEAD of the PHARMACY DEPARTMENT. Salary scale £500 by £25 to £600, plus War Bonus.

The College is approved by the Pharmaceutical Society of Great Britain for the Chemist and Druggist Qualifying Examination, the Pharmaceutical Chemist Qualifying Examination, and the Diploma in Biochemical Analysis. The College is also recognized by the University of London for the purposes of the B.Pharm. Degree.

Candidates must be Qualified Chemists, possess a degree in Pharmacy, or Science, of a British University, and have had teaching experience.

Forms of Application and further particulars may be obtained by sending a stamped addressed envelope to The Registrar, The Technical College, Sunderland, and forms of application should be returned to the undersigned not later than June 17, 1944.

W. THOMPSON,
Director of Education.
Education Offices,
15 John Street, Sunderland.

## ESSEX EDUCATION COMMITTEE

South-East Essex Technical College and School of Art, Longbridge Road, Dagenham.

Applications are invited for the permanent post of SENIOR LECTURER IN BIOLOGY as from September 1, 1944. Candidates should possess high academic qualifications and have had teaching experience. Some teaching of Physiology to B.Sc. General Standard would be an additional qualification. Research experience desirable.

Salary: Burnham (Provincial) Scale plus £40 for post of responsibility.

Further particulars and forms of application are obtainable, on receipt of a stamped addressed envelope, from the Clerk to the Governors at the College, to whom applications with copies of two recent testimonials should be sent by June 12, 1944.

B. E. LAWRENCE,
Chief Education Officer.
County Offices, Chelmsford.

## BRADFORD EDUCATION COMMITTEE

TECHNICAL COLLEGE, BRADFORD

Applications are invited for appointment as HEAD of the DEPARTMENT OF PHYSICS in the College vacant upon the appointment of Dr. J. P. Andrews as Assistant Professor of Physics at Queen Mary College (University of London).

The scale of salary attached to this appointment will be £600 to £700 per annum. A war bonus of £52 per annum is, at present, also paid.

Further particulars of the appointment and forms of application may be obtained from the Director of Education, Town Hall, Bradford, and completed forms should be returned to the Principal of the College not later than Saturday, June 17, 1944.

THOS. BOYCE,
Director of Education.

## LONDON (ROYAL FREE HOSPITAL) SCHOOL OF MEDICINE FOR WOMEN

(UNIVERSITY OF LONDON)

8 Hunter Street, Brunswick Sq., London, W.C.1

Applications are invited from men and women holding degrees in Physiology or Medicine for the post of DEMONSTRATOR in the PHYSIOLOGY DEPARTMENT, from October 1, 1944, at an initial salary of £250 per annum, with superannuation benefits and war allowance.

Further particulars may be obtained from the Warden and Secretary, to whom applications should be sent by June 9, 1944.

NANCIE MOLLER,
May, 1944. Warden and Secretary.

## UNIVERSITY COLLEGE NOTTINGHAM

Applications are invited for the following appointments to fill two vacancies and five posts newly established to meet College developments:

Professor of BOTANY. Salary £900 per annum.

Assistant Lecturers in ECONOMIC HISTORY, GEOGRAPHY, BOTANY, and ZOOLOGY. Salary in each case £300 per annum.

ADULT EDUCATION: (*a*) ORGANIZING TUTOR for Derbyshire, (*b*) TUTOR IN PSYCHOLOGY, who will be required to undertake also some internal teaching duties. Salary in each case £400 per annum.

The conditions of these appointments and forms of application, which must be returned by Wednesday, June 14, may be obtained from The Registrar, University College, Nottingham.

## PORTSMOUTH MUNICIPAL COLLEGE

Principal: L. B. Benny, M.A.
Head of Engineering Dept.: W. G. Green, Ph.D., A.M.I.Mech.E.

Applications are invited for the position of LECTURER IN CIVIL ENGINEERING from candidates suitably qualified who are corporate members of the Institution of Civil Engineers.—Forms of application and particulars may be obtained from the Registrar, The Municipal College, Portsmouth.

E. G. BARNARD, M.A.,
Chief Education Officer.

## KING'S COLLEGE of HOUSEHOLD and SOCIAL SCIENCE

(UNIVERSITY OF LONDON)

Temporary Address:
c/o University College, Leicester.

Applications are invited for appointment as LECTURER IN DIETETICS in connection with course leading to University of London Academic Postgraduate Diploma in Dietetics. Duties will begin in October, 1944.

Applications, together with copies of three testimonials, should reach the Secretary (from whom further details may be obtained) not later than June 17, 1944.

## UNIVERSITY OF MANCHESTER

Applications are invited for the post of ASSISTANT LECTURER IN MATHEMATICS. Duties to commence September 29, 1944. Stipend £350 per annum. Qualifications in Pure Mathematics desirable.—Applications not later than June 26, 1944, to the Registrar, University, Manchester 13, from whom further particulars may be obtained.

## UNIVERSITY OF MANCHESTER

Applications are invited for the post of ASSISTANT LECTURER IN ENGINEERING. Stipend £350 per annum. Duties to commence September 29, 1944. Applications must be sent, not later than July 1, 1944, to the Registrar, The University, Manchester 13, from whom further particulars may be obtained.

**Physicist wanted: Essential War Work.** Age about 30 to 35. First-class academic qualifications and experience in postgraduate research essential. Work would include experience in various research departments of a North London firm specialising in optical instruments for scientific and industrial research and control. For a suitable man, the permanent post of Controller of Research and Development is in view after two years experience. Salary from £500, according to qualifications and experience. Applicants should write quoting A.518XA to the Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2, for the necessary forms, which should be returned completed on or before June 21, 1944.

**Wanted: a man with some training or** experience in scientific glassblowing. Good prospects of permanency. Applications in writing, giving age and details of position re Armed Forces Act, to Staff Department, I.C.I. Ltd., Dyestuffs Division, Hexagon House, Blackley, Manchester.

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

**Junior Laboratory Assistant (male).** Reply to Secretary, Department of Zoology and Comparative Anatomy, University Museum, Oxford.

**Biochemist, 38, British, M.Sc., Ph.D.,** F.R.I.C., reserved, desires Research post in Public Health, Agriculture or Industry. Long experience in hospital and factories (including control of staff); training in bacteriology, micro-respirometry; wide linguistic knowledge.—Write, Box 194, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

**Industrial Chemist, D.Ph., seeks suit**able employment. Twenty-five years' experience chemical manufacturing industry.—Box 193, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

**Urgently Required: one Pulfrich** Refractometer for measurement of refractive indices of both solids and liquids with an accuracy of about 0.0001 and dispersion to about 0.00002. Particulars of instruments and accessories available with prices to Box "W.E.S.," c/o 95 Bishopsgate, E.C.2.

**For Sale. Ross, First-class, Binocular** Microscope. Full equipment, many extras.—Watts, Garth, Offerton Rd., Hazelgrove, Ches.

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

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in Australia was paid by the late Prof. T. W. Edgeworth David, who said: "No one in Australia since the time of Robert Etheridge, Jnr., has more enriched our knowledge of the past forms of life in Australia than has this worker, whose ability is matched to a marvellous industry".

Chapman was personally a charming companion and loyal friend. He was ever willing to give those who sought his aid the benefit of his wide knowledge and great experience. Blessed with an even temperament, he had an old-world courtesy which never deserted him. His wide circle of correspondents throughout the world particularly will regret his passing. W. J. PARR.

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Mr. Arthur Earland supplements this account as follows:

Of recent years, much of Chapman's work on the Foraminifera was done in collaboration with Mr. W. J. Parr, including "A Classification of the Foraminifera", published in 1936, which is probably the best and most natural of the many efforts to deal with this difficult subject. They were also jointly responsible for the long-delayed report on the Foraminifera of the Australasian Antarctic (Mawson) Expedition of 1911–14, published in 1937.

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## Mr. C. B. Rickett

C. B. RICKETT, who died on April 8 at the age of ninety-two, was the last of a triumvirate of British ornithologists who did so much for the study of Chinese ornithology at the end of the nineteenth and beginning of the twentieth centuries.

Charles Boughey Rickett was born in Hong Kong on December 10, 1851, and was the son of John Rickett, who was in the service of the East India Company. At an early age he joined the Hong Kong and Shanghai Banking Corporation, and after serving in branches in India, Japan and Java, was appointed agent at Penang in 1885, and five years later was transferred to Foochow. He had been collecting birds while in the Straits, but he did not take this up seriously until he arrived at Foochow. J. D. La Touche had already written about the birds of that area, but Rickett, after four years work, was able to add much additional information.

The two ornithologists became great friends and wrote more than one joint paper. Through La Touche, Rickett came to know F. W. Styan, who was engaged in the tea trade and an authority on the birds found in the Yangtse Valley. The three carried out a joint trip to the hills north of Foochow which resulted in several interesting discoveries; later they combined to send Chinese collectors to less accessible parts of China—with valuable results.

Rickett was a good field observer, and his papers contained many interesting notes. His collections, amounting to some four thousand skins and a thousand eggs, and a considerable number of mammals, were presented to the British Museum. After his retirement he lived in England and finally settled in Reading. He was a very regular attendant at the monthly meetings of the British Ornithologists' Club up to his eightieth year, and was one of the best known and popular members. N. B. KINNEAR.

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WE regret to announce the following deaths:

Prof. Wilhelm von Mollendorf, professor of anatomy and director of the Anatomical Institute at the University of Zurich, aged fifty-seven.

Dr. Daniel M. Molloy, field director in Central America for the International Health Division of the Rockefeller Foundation, on January 29, aged sixty-one.

Mr. J. R. Norman, deputy keeper in the Department of Zoology, British Museum (Natural History), an authority on fishes, on May 26, aged forty-five.

Prof. S. Oberndorfer, director of the Institute of General and Experimental Pathology and of the Cancer Institute of Istamboul University, on March 1.

Prof. Wolfgang Ostwald, professor of colloid chemistry in the University of Leipzig, aged sixty.

Sir Herbert Thompson, Bart., the well-known Coptic scholar, on May 26, aged eighty-four.

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# NEWS and VIEWS

## Association of Teachers in Technical Institutions

SOME problems likely to face the technical colleges as a result of the application of the 1944 Education Bill formed the main theme of Mr. H. Wragg's presidential address to the Association of Teachers in Technical Institutions at the thirty-fifth annual conference. After indicating the needs of democracy for a knowledgeable and discerning electorate and ability "to create and develop ideas which will ameliorate the life of the community", Mr. Wragg surveyed the deficiencies of past educational legislation in so far as it touched the technical field, and welcomed the recognition given to the present junior technical schools by their being placed on the same footing as the grammar and modern schools. He directed attention to the problems involved in providing more school buildings and additional teachers to meet the expanding situation. The erection of new buildings takes considerable time but "time and cost of manufacture and erection are greatly reduced when many things of the same pattern are required". Mr. Wragg felt that teachers of building would find in this problem great scope for their energies. Already new junior technical schools of building have been opened. As to teachers, the vast number required (estimated at 50,000–100,000) "can only be secured if the profession is attractive to new entrants"; and revised salary scales are now under discussion (see also p. 663 of this issue). The need for close co-operation of technical colleges in compulsory part-time education from fifteen to eighteen was indicated, and the hope expressed that part-time day release would extend (voluntarily) until the age of twenty-one. Opportunities should be seized for expanding full-time courses for suitable students. The new Bill gives unsurpassed opportunities for local education authorities to erect "an all-embracing educational structure on the firm broad basis of primary and secondary education for all", with towers corresponding respectively to the universities and the technical, commercial and art colleges.

## The Nutrition Society

THE science of nutrition expanded so much of recent years that it was no longer adequately covered by existing societies. In July 1941, therefore, a proposal to form a nutrition society was put forward, under the auspices of the heads of various well-known institutes engaged in research on nutrition in Britain, which would follow on the lines of the Physiological and Biochemical Societies, although there was no question of publishing a journal at that time. At the first meeting in the same month, it was felt that the main object of the new Society should be to form a common meeting place for workers in the various fields of nutrition, namely, physiological, biochemical, agricultural, medical, sociological, economic and public health, and that it would be useful during the War to have a separate Scottish Group. The Society had not long been founded when it became apparent that the value of its proceedings would be enhanced by their reaching an audience wider than that which actually participated in its meetings. The Royal College of Physicians, impressed with the advantage which the medical profession might reap from gaining immediate access to the records of the meetings of the Society, made an offer which enabled the financial and other difficulties standing in the way of publication during war-time to be overcome. Accounts of the first meeting and of English and Scottish Group meetings up to May 30, 1942, are now published (*Proc. Nutrition Soc.*, 1, Nos. 1 and 2, 1–112; 1944) and include "Evaluation of Nutritional States; Food Production, Distribution and Supplies in Relation to Human Needs", and "Problems of Collective Feeding in War Time". The second double number will contain reports of meetings on dehydration, food supplies, trace elements and diet in pregnancy and lactation.

## British Medicine and the Göttingen Medical School

IN a recent paper (*Bull. Hist. Med.*, 14, 449; 1943) Prof. Max Neuburger remarks that during the eighteenth century inadequate facilities for teaching and research prevented most of the medical schools in Germany from furthering either medical training or scientific research. On the other hand, the medical school at Vienna and the Medical Faculty at Göttingen were remarkable exceptions, and owed their celebrity to two famous pupils of Boerhaave, namely, Gerhard van Swieten at Vienna and Albrecht v. Haller at Göttingen. George II, who founded the University of Göttingen in 1734, invited Haller to fill the vacant chair of medicine, which included anatomy, surgery and botany. Haller had previously spent some time in London, where he made the acquaintance of several English physicians and surgeons such as Sir Hans Sloane, John Pringle and William Cheselden, and frequently quoted British writers, notably Stephen Hales, John Mayow and Thomas Willis, in his own works. During the seventeen years when he resided at Göttingen, he exercised a great influence on the University, being responsible for the erection of an anatomical theatre, a botanical garden and a lying-in institution. He also founded a scientific society of which he was the first and permanent president, and a scientific journal to which he made more than a thousand contributions. Between 1739 and 1744 he completed the six-volume edition of Boerhaave's "Institutiones", for which he was elected a foreign member of the Royal Society. He was also author of numerous other works on anatomy, physiology, medicine, surgery and botany. In 1739 he was appointed physician in ordinary to George II, who conferred a knighthood upon him and made him one of his consultant physicians. Owing to reasons of health, he left Göttingen for Berne in 1753. Many of Haller's successors at Göttingen, as Prof. Neuburger points out, had studied in London. Among them may be mentioned Roederer, Sömmering, Thomas Young and Blumenbach.

## Quekett Microscopical Club

FOR some eighty years, the Quekett Microscopical Club has taken a leading part in the development of microscopy, and many leading research workers have been included on its membership roll and have recorded the results of their work in its journal. Thanks to the courtesy of the Royal Society, the Club, which at present has a membership of nearly three hundred and fifty, is now meeting at Burlington House, Piccadilly, where the Club's library and slide cabinet are again available, after having been removed to safety in the country during the last four years. Meetings are held as originally, on the second and fourth Tuesday in each month, the earlier being an ordinary (lecture) meeting, whereas the latter is devoted to the exhibition of specimens, apparatus and general discussion. On Saturday afternoons, collecting excursions are conducted and visits to places of interest to microscopists are arranged. The affairs of the Club are managed by two secretaries: Mr. E. P. Herlihy, 76 Brook Green, London, W.6, dealing with business matters, and Dr. James Davidson, 41 Brampton Grove, London, N.W.4, with scientific matters and papers.

## Chagas's Disease in Brazil

IN a recent paper (*Bol. Of. San. Panamericana*, 22, 773; 1943), C. Chagas, jun., states that during the thirty-three years since Chagas's disease was discovered in a small area in the State of Minas Gerais, Brazil, the disease has been found to have spread throughout North and South America. As regards the parasitology, it is now universally accepted that Schizotrypanum is the cause of the disease. Studies are now being made to obtain more complete data regarding insect vectors, prevalence of the disease and animal carriers of the virus. Among domestic animals, cats and dogs take the first place as carriers.

## Work at the Madrid Observatory

BULLETIN 9 from the Madrid Observatory deals first of all with the photographic and visual observations of Nova Lacertæ 1936, made at the Observatory. The photographs were obtained by means of a camera of short focus used in conjunction with the Grubb photographic equatorial, which has an aperture of 16 cm. and focal length 80 cm. The method employed for determining the magnitude of the nova was by measuring the diameters of the focal images, and applying the formulæ of Charlier and Parkhurst, adopting the mean from both formulæ. Nine comparison stars of various spectral types were used and the results are shown in Table 2, the observations extending over the period June 21–July 17, 1936. In addition to the photographic observations, about 500 visual observations were made between June 18 and July 20, the results of which are given in Table 3, and from these the colour-index was deduced. This varied according to the spectral type of comparison star; for Class $F0$ it was 0·30 and for Class $B8$ it was − 0·08, and was practically zero for Class *A*0. A curve shows the results of the photographic and visual determinations of magnitudes, the photographic magnitudes being represented by circles which lie close to the visual magnitude curve.

Similar work was done with Nova Herculis 1934, the observations extending from December 16, 1934, to April 30, 1935, and the light curve of the nova between these dates is given, circles representing the photographic magnitudes as in the case of Nova Lacertæ. A maximum difference occurred about the middle of January, this difference (photographic—visual) being 0·5 mag. It was found impossible to deduce the value of the colour-index, but it is hoped that this will be done when further data are available from various scientific journals, thus enabling comparisons to be made with the work at the Observatory of Madrid.

Bulletin 10 from the Observatory deals chiefly with solar prominences observed at the University of Valencia during 1938, and is a continuation of the 1937 observations recorded in a previous issue of the bulletin (see Nature, 151, 405; 1943). In addition to a description of the solar spots observed in 1938, the issue contains the positions of Comets van Gent, Whipple-Bernasconi-Kulin and Whipple-Fedtke, determined from photographic observations.

## Aeroplane Compass

In *Sky and Telescope* of January 1944 there is a description of the Gyro Flux Gate Compass System, which has overcome many difficulties for air navigators. It combines the action of the flux of the earth's magnetic field with a gyroscope designed to keep it horizontal in spite of the movements of the aeroplane. It is very much more sensitive than the ordinary compass, and it can be operated close to the earth's magnetic poles, if necessary. The existence of the instrument has been revealed recently, because it is believed that some of the compasses have fallen into the hands of the enemy, though it seems certain that he cannot produce it in great quantity during the present War. A description of the instrument is given; but the technical details are too complicated to be dealt with here. Its practical utility can be judged from the fact that its reading of true compass directions and its reliability under varying conditions have contributed to reduce the number of accidents due to uncertainties in navigation.

## Transmission Line Supports

In a paper on reinforced concrete supports read recently in London by Messrs. E. C. Neate and W. F. Bowling before the Institution of Electrical Engineers, consideration is first given to previous work done in Great Britain, and this is followed by a discussion of the requirements of a reinforced-concrete transmission-line pole. Details of experimental poles are given with an analysis of the results of tests to destruction. A graphical method of design is developed, and sufficient information is provided to enable future work to be undertaken on the bases established. An expression is obtained for the deflexion of a pole under load, and it is shown that deflexion cannot be taken as a criterion for proof-test purposes. The authors discuss fabrication and erection methods, and the paper concludes with a survey of the advantages and disadvantages of the concrete pole, reference being made to a *questionnaire* issued to a number of users in Great Britain.

## St. Louis Chapter of the Society of the Sigma Xi

The St. Louis Chapter of the Society of the Sigma Xi was installed at St. Louis University on March 16 by Prof. Harlow Shapley and Prof. George A. Baitsell. Forty members and three associate members formed the petitioning group. Prof. Shapley spoke on "Co-operation in Research", and later, Prof. Peter Debye gave the Sigma Xi Lecture, "The Magnetic Approach to Absolute Zero". Chapter officers elected for the following year were Kermit Christensen (president), Charles H. Neilson (vice-president), Arthur G. Rouse (secretary) and Alfred H. Weber (treasurer).

## Announcements

The Albert Gold Medal of the Royal Society of Arts has been awarded to Sir Henry Tizard, president of Magdalen College, Oxford, and formerly rector of the Imperial College of Science and Technology, distinguished for his scientific work in the development of aircraft (see Nature, Aug. 1, 1942, p. 148).

The first award of a gold medal founded in memory of Dr. Bimala Churn Law by the Indian Association for the Cultivation of Science has been made to Sir Henry Dale, president of the Royal Society. The award is given for important contributions to science including medicine.

Prof. John MacMurray, Grote professor of the philosophy of mind and logic in the University of London, has been appointed professor of moral philosophy in the University of Edinburgh in succession to Prof. A. E. Taylor.

Dr. S. W. Wooldridge, reader in geography in the University of London (King's College), has been appointed to the chair of geography in the University tenable at Birkbeck College, in succession to Prof. E. G. R. Taylor.

At the anniversary meeting of the Linnean Society of London held on May 24 the president, Mr. A. D. Cotton, delivered a presidential address, "The Megaphytic Habit in the African Tree Senecios and other Genera". The following were elected officers for the year 1944–45: *President*, Mr. A. D. Cotton; *Treasurer*, Colonel F. C. Stern; *Deputy Treasurer*, Dr. B. Barnes; *Secretaries*, Dr. B. Barnes (botany) and Dr. Malcolm A. Smith (zoology); *Members of Council*, Prof. A. J. E. Cave, Captain Cyril Diver, Dr. Edward Hindle, Mr. A. A. Pearson, Lieut.-Colonel R. B. Seymour Sewell.

Lord Kemsley has made a gift to the University of Sheffield to provide, during a period of seven years from its first coming into operation, an annual travelling fellowship of £400 a year. The fellowship will come into operation as soon as circumstances allow its conditions to be fulfilled. Candidates must be unmarried men and British subjects by birth holding the degree of bachelor of the University of Sheffield and who since graduation have not taken up other full-time work than study or research in a university in the United Kingdom. The main condition of tenure is that the Fellow shall actively study at first hand the ways of a good life and of thought in the country selected, and shall become efficient in speaking and reading its language. Candidates will generally be selected from the Faculty of Arts. No applications will be accepted before a date to be announced in due course by the University of Sheffield.

# LETTERS TO THE EDITORS

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

## Vertical Section of a Coral Atoll

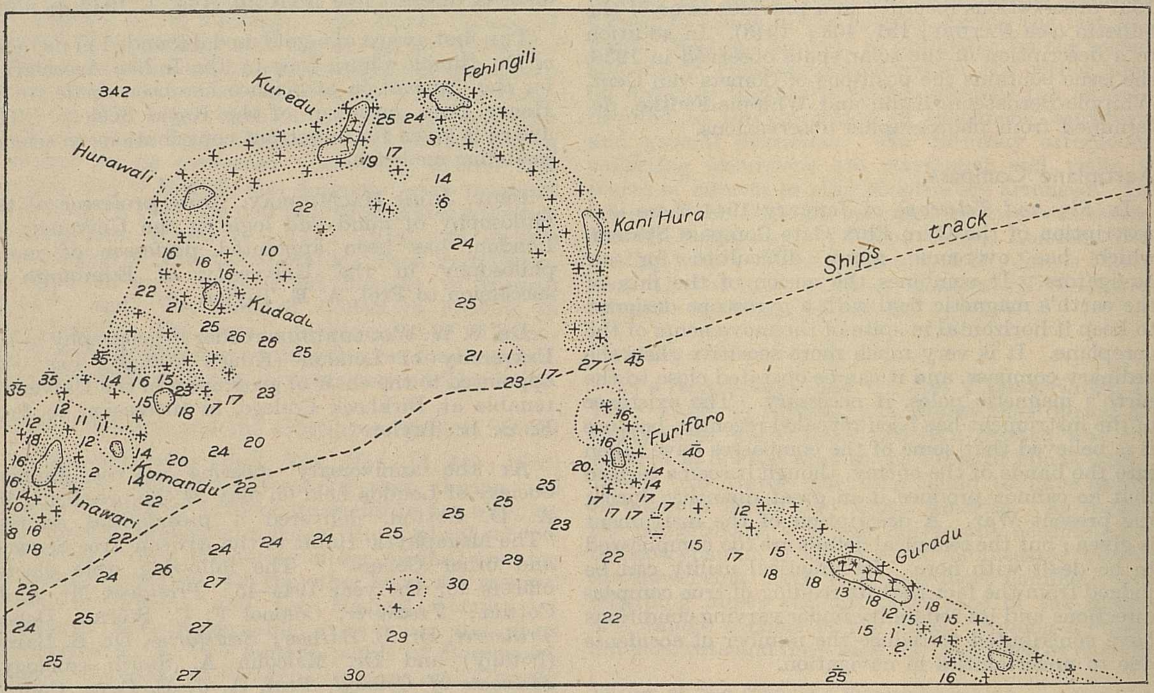
RECENTLY, Captain A. G. N. Wyatt, R.N., in one of H.M. ships, visited Fadiffolu Atoll in the Maldive Islands, and opportunity was taken to run a line of soundings across the atoll and to carry it on into deep water to a distance of some 5¾ miles from the rim.

An interesting feature of this work was the control. While in sight of the islets it was, of course, possible to fix the position of the soundings by cross bearings, but it is probably the first time that such a section has been controlled by taut-wire measurement over the rim of an atoll, so that it can be stated that the depths which were recorded continuously by echo soundings show a completely accurate determination of the contour of the sea-bed from within the atoll, where depths of rather more than 20 fathoms were obtained, into deep water of more than 1,000 fathoms.

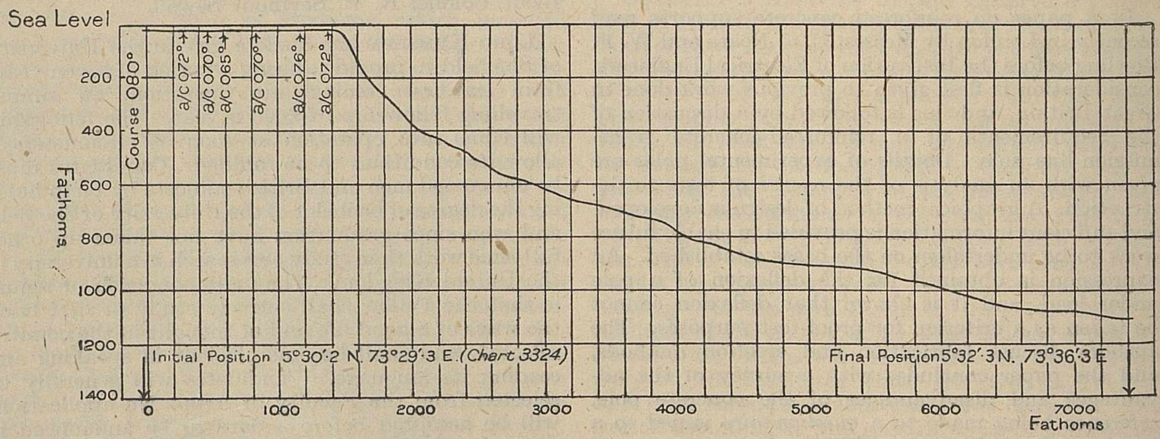
The accompanying sketch is from Admiralty Chart No. 3324, and the section below shows the form of the sea-bed.

Hydrographic Department,
Admiralty, London, S.W.1.

J. A. EDGELL.




MALDIVE ISLANDS. FADIFFOLU ATOLL (NORTHERN PORTION)




MALDIVE ISLANDS. FADIFFOLU ATOLL. SECTION DRAWN ON A LINE 072° THROUGH THE N.E. ENTRANCE TO THE LAGOON.

## Fatigue in Selenium Rectifier Photocells

FATIGUE in selenium rectifier photocells is generally marked by a falling off in the current output, during exposure to steady radiation, of cells which have been kept for some time in darkness. The rate of decrease is greatest initially and diminishes until a practically steady current is attained after perhaps several hours. If the cell be again darkened, recovery takes place. According to most investigators, recovery is a much slower process than fatigue.

Elvegard, Lindroth and Larsson[1], and more recently R. A. Houstoun[2], found that the degree of fatigue depends on the spectral quality of the radiation. They attempted no explanation of their results in terms of other properties of the cells, however. Incidental observations made at the National Physical Laboratory, during measurements of the spectral sensitivity of a number of cells, afford some new results of which a tentative explanation is possible.

It was found that: (1) When cells were exposed to radiation of wave-length greater than 0·64 μ the current fell by 10 per cent in a few minutes. When the cell was afterwards darkened, recovery occurred at a similar rate. (1*a*) A few seconds exposure to overcast daylight depressed the sensitivity for wave-lengths exceeding 0·64 μ by 20–25 per cent. Recovery was fairly rapid during subsequent tests with red light of comparatively low intensity. (2) With rare exceptions fatigue did not occur, or was barely detectable, with radiation of wave-lengths less than 0·62 μ. (3) Effects (1) and (2) were independent—exposure to light of either of the two spectral regions had no effect on the result of subsequent exposure to light of the other region.

In these experiments the cells were exposed to radiation within narrow spectrum bands (width about 100 A.). The whole of the cell surface was exposed. The resistance of the external circuit was effectively zero and the photocurrent was about 1 microamp. These conditions, and the results obtained, are not in all respects the same as in the experiments of the investigators mentioned. In particular, the photocurrent was much smaller in the present experiments. It was found, however, that the behaviour described could also be observed when the photocurrent was about 50 microamp. To show this, the cells were exposed to a tungsten lamp, signal-green and signal-red glasses being used to isolate the two spectral regions.

The behaviour described here is probably connected with the extent of penetration of the radiation into the selenium. Selenium has a fairly high transmission for wave-lengths greater than 0·64 μ, and is practically opaque for wave-lengths less than 0·60 μ. This would account for the different behaviour observed on exposure to the two spectral regions, for the photoelectric action would take place in layers situated at different depths depending on the penetration of the radiation. Moreover, we should expect the fatigue to be greatest when the action is in the deeper layers and least when only the superficial layer is concerned, the effect observed in our experiments.

The cells used in our experiments were supplied by Messrs. Evans Electroselenium, Ltd.

J. S. PRESTON.

Light Division, National Physical Laboratory,
Teddington, Middlesex. March 20.

[1] *J. Opt. Soc. Amer.*, **28**, 33 (1938).
[2] *Phil. Mag.*, **31**, 498 (1941).

## Mathematics of Biological Assay

BIOLOGICAL assays may be divided into two main classes. In the first, which we may call Type I, the 'potency' of the test material, as compared with that of a standard preparation, refers only to its relative ability to produce certain effects in the experimental animals, no assumptions being made as to the substance or substances responsible for the effects. An example is the testing of extracts from plants for their insecticidal power. In Type II, however—and this must now be the larger class—the response of the experimental animals is used to estimate the content, in units of some kind (which may be either of an *ad hoc* nature or actual units of weight) per unit weight of test material, of a single substance producing the response in question. Into this category fall, for example, most assays of vitamins.

My previous letter[1] on the theory of the 4-point experimental design was intended to show that the method was of both wider applicability and greater accuracy than N. T. Gridgeman[2] had assumed. I was at the time, I admit, thinking only of Type II assays. D. J. Finney has now rightly pointed out[3] that in certain assays (which, as will be seen later, must be all of Type I) the method may be quite invalid. I feel, however, that some readers might be unduly frightened off the 4-point method by Mr. Finney's letter, as much as some others might be led into unjustifiable use of it by mine. It is perhaps worth while, therefore, to consider further the criteria to be satisfied in order that the 4-point method may be valid.

All biological assays begin by being of Type I. They are transferred to the Type II group as soon as the progress of knowledge makes it plausible to assume that the responses of experimental animals dosed with the standard preparation and those dosed with the test preparation are qualitatively identical and caused by the same factor $F$ in both preparations; and that this factor, whether chemically an element or a compound, is single in nature and uniquely responsible for the effect. This assumption must be regarded as experimentally established before the conclusion "This material is 10 times more potent than the standard", which is typical of Type I assays, can be translated into "This material contains 10 times more of the factor $F$ than does the standard", equally typical of Type II assays. (Whether or not the further step to "This material contains $U$ units of the factor $F$ per gram" is made is irrelevant.) Moreover, the assumption in question is inherent in the experimental design of any normal Type II assay—in the interests of brevity the reader is left to check this point for himself.

But if the experimental response to dosage is caused by a single factor $F$ and by nothing else, then the test and standard preparations must behave as solutions of the factor $F$, of different concentrations, in a biologically inert diluent; and the relation between the response $Y$ and the log-dose $X$, whatever its form may be, must be the same in both cases. In fact, if the doses are measured not in terms of the weight of preparation given but in units of the factor $F$ contained therein, all the experimental data are points on the same curve. In so far as this is not true, the translation of 'potency' into 'content of factor $F$' *will be in error, whether the method of assay adopted was the 4-point one or not.* In any valid Type II assay, however, there are not merely (to quote Mr. Finney) "strong *a priori* reasons for believing that the standard and test preparations have response curves of identical form"—this assumption is, as just stated, fundamental to the design of the experiment and the interpretation of the results. In such cases, the 4-point method of assay correctly estimates the relative potency of the test and standard preparations, provided that the relationship between $Y$ and $X$ is of the form

$$Y = a + bX + cX^2,$$

which, at least over the range of doses employed in practice, may justifiably be assumed to be true. (Even if there are cubic and higher terms in $X$, the 4-point method will be in error to an extent which is insignificant compared with the irreducible error of all biological assays.)

Summing up, therefore, a 4-point method of assay is perfectly justifiable, and will give an accurate estimate of the relative potencies of two preparations, in all cases where the response of the experimental animals is assumed to be caused by a single factor present in both and to be uninfluenced by any other constituent of either. In assays in which this assumption is not made, the 4-point assay *may* still be valid if there are cogent reasons, derived from previous work, for assuming that the standard and test preparations have response curves of identical form. In all other cases, the 4-point assay is unjustifiable, will probably result in grave error, and should not be employed.

Mr. Finney has seen this letter and is in full agreement with it. He suggests, however, that attention should be directed to the desirability of so arranging the dosages that the responses to the test and standard preparations are not very different. A working rule, which provides a good factor of safety in avoiding certain possibilities of error, is to regard as only tentative any conclusions drawn from a 4-point assay unless the response to one of the two doses of the test material falls between the responses to the two doses of the standard preparation.

The conclusion of Mr. Finney's letter to me might fittingly conclude this letter also. "I think that the decision on a suitable assay procedure is mainly one for the biologist or chemist involved, not a matter of abstruse mathematical theory, and he must make this decision in the light of his experience and knowledge of the material in question."

ERIC C. WOOD.

Virol Limited,
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Ealing, W.5.

[1] Wood, E. C., NATURE, 153, 84 (1944).
[2] Gridgeman, N. T., *Biochem. J.*, 37, 127 (1943).
[3] Finney, D. J., NATURE, 153, 284 (1944).

## Fluctuations in the Porosity of Egg-Shells

DURING the course of an experiment designed to study the effect of different levels of dietary calcium on various egg-shell characteristics, measurements were made of the porosity of egg-shells. Eggs were collected from twelve birds in all during a period lasting from mid-December to mid-January. At first, four birds received a high-, four a medium-, and four a low-calcium diet; later, all twelve received the medium-calcium diet. A basal ration low in calcium was used, and to this was added 8, 4 and 0 per cent of calcium carbonate to give the high-, medium- and low-calcium diets respectively.

Porosity was measured by calculating the loss in weight in milligrams per day per square centimetre of surface area under standard conditions of humidity and temperature, total surface area being calculated from Dunn's formula[1], as modified by Mueller and Scott[2]. The porosity value obtained will be referred to as the porosity coefficient.

Considering birds on the high- and on the medium-calcium diets, it was observed that in thirty-five out of forty-one clutches produced, the first egg of the clutch had a porosity coefficient less than that of any of the remaining eggs in the clutch—a clutch being here defined as a series of eggs laid on successive days, with one or more days of rest from laying between the clutches.

As examples of these variations in porosity coefficients, values for bird 2, which was first on the high- and then on the medium-calcium diet, and for bird 5, which was on the medium-calcium diet throughout, are given in Table 1.

TABLE 1.

BIRD 2.

| Clutch No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Days of rest before clutch | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| Porosity coefficients of successive eggs in clutch 1st | 1·84 | 2·00 | 1·85 | 2·22 | 2·05 | 1·99* | 1·82 |
| 2nd | 2·67 | 2·49 | 2·28 | 2·35 | | 2·22 | 2·37 |
| 3rd | 2·21 | | 2·38 | | | 2·38 | 2·55 |
| 4th | 2·26 | | | | | 2·41 | 2·48 |
| 5th | 2·14 | | | | | 2·39 | 2·33 |
| 6th | 2·13 | | | | | 2·47 | |
| 7th | 2·25 | | | | | | |

BIRD 5.

| Clutch No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Days of rest before clutch | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| Porosity coefficients of successive eggs in clutch 1st | 1·88 | 1·89 | 1·90 | 1·64 | 2·09 | 2·06 | 2·14 |
| 2nd | 2·09 | 2·14 | | 2·52 | 2·35 | 2·13 | 2·30 |
| 3rd | 2·25 | 2·19 | | | 2·43 | 2·31 | 2·30 |
| 4th | 2·32 | 2·41 | | | | 2·19 | 2·27 |
| 5th | | | | | | 2·30 | |

*First egg on medium-calcium diet.

The birds on the low-calcium diet soon ceased to lay, and their calcium metabolism was profoundly disturbed, as shown by the gradual thinning of the shells and a general increase in porosity coefficients; however, even these birds displayed a similar tendency, though less pronounced, for the first egg of a clutch to have a smaller porosity coefficient than succeeding eggs of the clutch. Porosity coefficients for bird 12 are shown in Table 2.

TABLE 2.

BIRD 12.

| Clutch No. | | 1 | 2 | 3 |
|---|---|---|---|---|
| Days of rest before clutch | | 1 | 1 | 1 |
| Porosity coefficients of successive eggs in clutch | 1st | 3·52 | 2·30 | 2·69 |
| | 2nd | 2·36 | 2·78 | 4·36 |
| | 3rd | 2·84 | 3·26 | |

It should be clearly understood that the low porosity coefficient of the first egg of a clutch is not caused by a thicker shell. A large number of shell thicknesses have been measured, and there is no indication of a relationship between shell thickness and porosity coefficients, except, as mentioned above, where shells become abnormally thin on the low-calcium diet.

Common and Hale[3], and Tyler and Willcox[4], while expressing their views somewhat differently, are in substantial agreement concerning mobilization of bone calcium by laying hens. They have suggested that the bones of laying hens have two types of calcium reserve from which the bird can draw when the calcium absorbed from the food is insufficient to provide for all the shell calcium. The more readily mobilized reserve has a relatively high calcium – phosphorus ratio (there is evidence that the ratio, under certain conditions, may be infinitely high, that is, that calcium may be withdrawn without a corresponding withdrawal of phosphorus), while the less readily mobilized reserve has a relatively low calcium – phosphorus ratio. The chief source of bone calcium for the first egg of a clutch is the more readily available reserve, whereas the relatively less available reserve is drawn upon to a progressively greater degree for the succeeding eggs of the clutch.

It is too early yet to link up the differences in porosity with this conception of different types of bone calcium, but the possible connexion should be borne in mind when attempts are made to explain these porosity changes.

It is hoped to publish a fuller account of this work at a later date.

D. J. G. BLACK.
Department of Agriculture,
CYRIL TYLER.
Department of Agricultural Chemistry,
The University, Reading.

[1] Dunn, L. C., *Poult. Sci.*, 2, 166 (1923).
[2] Mueller, C. D., and Scott, H. M., *Poult. Sci.*, 19, 163 (1940).
[3] Common, R. H., and Hale, R. W., *J. Agric. Sci.*, 31, 415 (1941).
[4] Tyler, C., and Willcox, J. S., *J. Agric. Sci.*, 32, 43 (1942).

## Effects of X-Rays on Erythrocytes Irradiated *in vitro*

IRRADIATION of erythrocytes with X-rays *in vitro* causes hæmolysis. The dose of X-rays required to obtain complete hæmolysis is influenced by the concentration of the erythrocyte suspension and by the medium. A state of resistance to hæmolysis results when a dose of two million r. is given to an erythrocyte concentration of 0·1 per cent or less in normal saline[1]. The question arises, whether these erythrocytes are resistant to other hæmolysins or only to the X-rays producing this stable state.

To answer this question, experiments were undertaken in which erythrocytes made resistant to hæmolysis by X-ray irradiation were exposed to the hæmolytic effect of light and saponin respectively.

(1) Human or rabbit erythrocytes in 0·1 per cent suspensions in normal saline in hanging drops under mica slides were irradiated with doses of 2 million *r* (35 kV. 15 milliamp. copper anode 3 cm. distance). After 24 hours there was no hæmolysis. Then after addition of eosin solution to the irradiated drops and to non-irradiated control drops both were exposed to sunlight. Hæmolysis occurred in the control drops after 10–20 min., while in the X-irradiated drops no hæmolysis took place after 1–2 hours.

(2) Solutions of saponin were added in different concentrations to erythrocytes prepared and irradiated in the same manner as in the foregoing experiments. In non-irradiated control drops, addition of one drop of saponin solution (1 : 15,000) caused hæmolysis in about 5 min., while concentrations of 1 : 3,000 were not hæmolytic to the pre-irradiated erythrocytes after 24 hours.

The results of these experiments suggest that two different effects of X-rays on erythrocytes are possible, one of which causes complete hæmolysis, whereas the other, on the contrary, causes the erythrocytes to become resistant to the hæmolytic effect of X-rays, light or saponin.

Whether one or the other effect takes place depends on the concentration of the erythrocyte suspension in normal saline and the dose of X-rays. The resistance to hæmolysis fails to appear if serum is added to the normal saline or if the erythrocytes are irradiated in glucose solution.

L. HALBERSTAEDTER.
Department of Radiology,
Cancer Laboratories,
Hebrew University,
Jerusalem.
March 14.

[1] Halberstaedter, L., and Goldhaber, G., *Proc. Soc. Exper. Biol. and Med.*, December 1943.

## Vitamin C in Plants

### 'Nasturtium' (*Tropaeoleum majus*)

THE nasturtium, *Tropæoleum majus*, a native of Peru, flourishes throughout New Zealand. The leaves, which are used as a salad food, are very rich in vitamin C, the concentration ranging from 200 to 465 mgm. per 100 gm. in the samples tested. As a rule, the leaves of any particular plant show much less variation than this, although small leaves tend to have higher values than large leaves. Stalks contain 100–160 mgm. per 100 gm. and are therefore also a rich source. Little or no dehydroascorbic acid is present, although the ascorbic acid oxidase is exceedingly active in disintegrated tissues.

The ascorbic acid was titrated visually in 1 per cent metaphosphoric acid extracts with dichlorophenolindophenol solution. That the reducing properties of the extract are correctly attributed to ascorbic acid is proved by the rapid enzymatic oxidation which takes place in extracts unless prevented by boiling, or addition of metaphosphoric acid, etc. Also, a 60 per cent yield of pure dinitrophenylosazone of dehydroascorbic acid was obtained from an extract made with boiling water, oxidized with iodine and treated with dinitrophenylhydrazine.

An extract for addition to the diet of babies is readily prepared by adding nasturtium leaves to boiling water until no more can be immersed, boiling three minutes longer and draining. This extract normally contains more than 150 mgm. of ascorbic acid per 100 ml., and sealed away from air is fairly stable. It has not the pungent taste of the fresh leaves, this being lost during the boiling.

The nasturtium is a particularly suitable plant for investigation of ascorbic acid distribution, synthesis, etc., and merits more detailed study.

I wish to thank Dr. Guy Chapman for the suggestion that the nasturtium should be examined for vitamin C, and also Mr. K. Griffin, Government analyst, Auckland, for his interest and encouragement.

MAURICE D. SUTHERLAND.
Dominion Laboratory,
Auckland, N.Z.
March 1.

### Iris (*Iris germanica*)

THE communications that have appeared in NATURE during the past few years in which rose hips, pine needles, etc., have been suggested as sources of vitamin C, prompt me to direct attention to the leaves of the common European iris (*Iris germanica*) as a superior material from which this vitamin can be readily prepared in substantial quantity. Unlike fruits, the ascorbic acid of which increases as they ripen, the leaves of most plants contain the largest amount when young[1]; most of the vitamin rapidly disappears from leaves as the plants mature. With Iris, however, the ascorbic acid content of fresh undried leaves, which is 0·6 per cent in the spring, does not fall below 0·3 per cent as the season advances. Few plant materials contain as high a concentration as that found in Iris leaves even at the end of the season (at least in the vicinity of New York City). The leaves are heavy and can be cut with little injury to the root-stalks. The vitamin is separated from the gums and other substances present in press juice far more easily than from any other source we have used[2].

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Gun Hill Road,
Nr. Jerome Avenue,
New York.
March 14.

[1] Marine, D., Baumann, E. J., and Webster, B., *J. Biol. Chem.*, **89**, 213 (1930).

[2] Baumann, E. J., and Metzger, N., *Proc. Soc. Exp. Biol. and Med.*, **30**, 1268 (1933).

## Indian Gooseberry (*Phyllanthus emblica*)

THE need at the moment, especially of the Fighting Forces, for vitamin C has provided the urge for establishing more natural sources rich in this vitamin. Recent search has revealed that walnut[1], rose hips[2] and parsley[3] are among the most potent. The earlier, already familiar, sources are cited in Thorpe[4]. I wish to direct attention to the existence of another rich source, namely, the Indian gooseberry, discovered more than eight years ago, but missed by subsequent workers abroad and recently rediscovered by Chen *et al.*[5], from China.

In a general investigation on the vitamin C content of Indian plant materials, undertaken by me early in 1935 at the Biochemical Laboratory, University of Madras, in collaboration with Dr. M. Damodaran (senior author), it was observed and reported that the Indian gooseberry, *Phyllanthus emblica* L., contains as much as 290–468 mgm. per cent of the vitamin[6]. According to later workers in India and in the East Indies, the vitamin content of this fruit is even higher: 540 mgm. per cent[7], 720 mgm. per cent[8] of the fresh pulp and 921 mgm. per 100 ml. of the juice[5]. In the original publication[6] it was also reported that the gooseberry fruit, unlike most other plant sources, has the merit of possessing a mechanism capable of protecting ascorbic acid from oxidation, so that the vitamin remains largely intact, even in the desiccated fruit.

The fruit, it is understood[9], is now being utilized by the Food Department of the Government of India for making edible preparations intended to meet, in some measure, the vitamin C requirements of the Indian Fighting Forces. Khan[10] has reported that the gooseberry fruit has been found very useful in the treatment of cases of human scurvy in the Hissar famine of 1939–40. History has it that an attack of scurvy in the Indian army at Nassirbad in Rajputana in 1837 was treated successfully with an extract of the dried fruits[11]. The fruit is known in Hindi as *amla* and the tree is widely distributed in India and Burma.

M. SRINIVASAN.

'Pradhan',
Poona, 4.

[1] NATURE, **150**, 267 (1942).

[2] *Biochem. J.*, **36**, 336 (1942).

[3] NATURE, **152**, 92 (1942).

[4] "Dictionary of Applied Chemistry", **1**, 503 (1941).

[5] NATURE, **152**, 596 (1943).

[6] *Curr. Sci.*, **3**, 553 (1935); *Proc. Indian Acad. Sci.*, 2B, 377 (1935).

[7] *Arch. Neerl. Physiol. de l'Homme et des Animaux*, **23**, 433 (1938).

[8] *Indian J. Med. Res.*, **26**, 165 (1938).

[9] Private communication from the Foodstuffs Directorate.

[10] *Indian Med. Gaz.*, **77**, 6 (1942).

[11] *Lancet*, **11**, 322 (1919).

## Early Human Embryos

WE read with interest the short account of the nine–ten day human embryo described by Prof. Francis Davies in NATURE of April 15. This embryo is obviously of great importance and value to the study of early human development, in which such significant advances have been made in the past few years. Prof. Davies compares his specimen with the human ovum *Wi*-8004 described, in a preliminary communication, by Rock and Hertig[1], and he states that "these two ova represent the earliest specimens of fully implanted human ova yet discovered". In fairness to Drs. Hertig and Rock, who have made such valuable contributions to this field of embryology, we think it should be pointed out that one of the ova (*Mu*—8020) described by them is estimated to be 7·5 days old and is in the earliest stage of human intra-uterine development so far described. This ovum is, of course, at a very much earlier stage of development than that described by Prof. Davies. Even the next older specimen of Rock and Hertig (*Wi*—8004), the one to which Prof. Davies refers, is not, unlike Prof. Davies's specimen, completely implanted. To quote Rock and Hertig: "the defective endometrial epithelium has been partially repaired and is in the process of closing the defect created by the implanting ovum". A comparison of the photograph of Prof. Davies's specimen with the photograph of *Wi*—8004 in Rock and Hertig's communication leaves us in no doubt that the former is in a more advanced stage of development and of implantation.

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[1] Rock, J., and Hertig, A. T., *Amer. J. Obstet. Gynecol.*, **44**, 973 (1942).

Rock and Hertig[1] explicitly described their 7·5-day ovum (*Mu*—8020) as "implanted on" the endometrium; that is, this ovum has only just begun to embed itself and a large part of the ovum is still freely exposed in the uterine cavity. On the other hand, they referred to their older ova (including the 9·5-day ovum, *Wi*—8004) as "implanted within", "embedded in" the endometrium. In the limits of a short letter, I thus deliberately confined my comparison to "fully implanted" specimens, by which I mean specimens in which no part of the embryonic tissues is exposed freely to the uterine cavity. If completeness of endometrial epithelialization is to be the criterion determining whether an ovum is fully implanted or not, then my specimen is not so far advanced *in this respect* as the *Wi*—8004 ovum, in that no surface epithelialization has yet commenced in my specimen, but the embryonic tissues are separated from the uterine cavity by the maternal fibrinous elements of the operculum. This process of epithelialization evidently takes a considerable time, since it is not complete even in the 11·5- and 12·5-day Hertig-Rock ova[2], by which time the "fully-implanted" ovum has undergone considerable advance in development beyond the stage shown in my specimen.

But such trivialities mask the important principle that the various elements in human ova of approximately the same age may show considerable differences in the stage of development which they have attained; such has been shown also in macaque embryos by Heuser and Streeter[3]. Whereas the general organization of my specimen is similar to that of the 9·5-day Rock–Hertig ovum (*Wi*—8004), some features of the latter are more developed (for example, partial surface epithelialization, two-layered endoderm), and some are less developed (for example, total size of ovum, thickness of trophoblast) than in my specimen. I have discussed the above points fully in a paper I have submitted for publication elsewhere.

I therefore still maintain that "these two ova represent the earliest specimens of fully implanted human ova yet discovered", and that the detailed differences between them are compatible with their being approximately the same age. I naturally share the admiration of Profs. Hamilton and Boyd for the work of Rock and Hertig.

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[1] Rock, J., and Hertig, A. T., *Amer. J. Obstet. Gynecol.*, 44, 973 (1942).

[2] Hertig, A. T., and Rock, J., Contrib. Embryol. Carnegie Inst. Wash., 29, No. 184, 127 (1941).

[3] Heuser, C. H., and Streeter, G. L., Contrib. Embryol. Carnegie Inst. Wash., 29, No. 181, 15 (1941).

## Display and Bower-building in Bower-birds

An investigation was carried out on the fairly typical bower-bird, *Ptilinorhynchus violaceus*, during 1939–41 in the Zoology Department of the University of Sydney and in rain-forests of eastern Australia. A full report of the investigation is at present in the Fisher Library in the University. The War having interfered with publication, the general conclusions reached are summarized below.

(1) The annual cycle of display and bower-building is dependent on the gonads and is stimulated by the same environmental factors that initiate actual breeding in other birds of the locality. Increasing light may be the principal stimulus; food and temperature have nothing to do with it.

(2) The male has already selected, or has been selected by, his mate when he arrives at his bower-territory after leaving the off-season feeding-flock in July. Thus bowers and decorations have little to do with sexual selection, which may have taken place during the winter flocking. It seems that the primary function of display and its associated specializations (bower, colour, 'decorations', noise, etc.) is to stimulate male and female reproductive systems as a prelude to successful fertilization. It is probable that external stimuli from the bower, etc., pass through visual and auditory receptors to the central nervous system and thence through the anterior pituitary to the gonads. Gonadectomy inhibits bower-construction and display. (Attempts to remove the anterior pituitary ended fatally.)

(3) Display and decoration of the bower begin in July–August: it is not until September–October that nesting begins.

(4) In the selection of its coloured 'decorations' or playthings the male Ptilinorhynchus closely matches the colours, especially the conspicuous epigamic features, of the female. During male display the female takes little or no active part—she may be absent or impassively present. The male's colour choices (blue, lemon-yellow and grey-brown) may serve the function of exciting himself by their resemblance to female colours.

(5) Some male birds paint or plaster the inner walls of their bowers with fruit-pulp, macerated wood or charcoal and other substances. The habit of painting coincides with that of breeding and not that of display.

(6) At least one species of bower-bird (Ptilinorhynchus), probably a second (*Chlamydera cervini-ventris*) and possibly a third orientate their bowers across the sun's path.

(7) When the female leaves the bower-territory in September–October, she alone begins nidification and incubation, often in a part of the forest distant from the bower. The male continues his display without an audience and with undiminished vigour. This continues almost without interruption until January, when the female and her young arrive at the bower and a communal display takes place. In a few weeks, or days, the bower is deserted or wrecked, and the family party joins one of the large gregarious feeding flocks which are moving noisily through the fruit-bearing trees of the forest. In these flocks, numbering from ten to a hundred, a minor form of display is constantly taking place. The family parties are broken up in the feeding flocks.

A. J. Marshall.

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## A Simple Technique for Photomicrography

Dr. Leak's article in Nature of May 6 has interested me very much; it describes a procedure which I think I was responsible for 35 years ago when I was working at Santa Elena in Entre Rios, Argentina.

I had an early Leitz microscope, and was interested in Texas cattle fever, blackwater and other trypanosome diseases. I had a good Kodak camera, and I also had a very early Kodak 'Brownie' camera making pictures on roll film about 2¼ in. by 2¼ in.—price 5*s*.—without view-finder. This little camera was so small and easily balanced that I found it unnecessary to do more than set up the microscope with the optical axis vertical, focus the object as for ocular observation as accurately as might be, and simply place the camera on the eyepiece, which was large enough to hold it quite safely without any other support, centring the lens by judgment and opening the shutter as smoothly as I could. I used a Welsbach mantle gas burner for the illumination.

Most of the pictures I took at that time were equal to anything I have taken since, even with very much more elaborate and expensive equipment. Unfortunately, I have preserved no prints or films.

J. Leonard Bowen.

9 The Wiend, Bebington,
Cheshire. May 8.

# EFFECTS OF CARBON DIOXIDE ON THE HEART AND CIRCULATION

IN his presidential address to the Physiology Section of the thirty-first Indian Science Congress held in January, Dr. S. N. Mathur discussed the physiological importance of carbon dioxide. Carbon dioxide has generally been regarded as a toxic waste product which the body seeks to eliminate as rapidly as possible, but it is now well recognized that it has certain beneficial actions as well. Originally a necessary evil, it has, in the course of evolution, so inextricably worked its way into the body machinery that it has come to be indispensable for certain physiological processes. The necessity of carbon dioxide for maintaining the *p*H of the blood and the activity of the respiratory centre is, of course, well known; its importance for the proper working of the cardio-vascular system is less well appreciated, and this field, in which Dr. Mathur has made important observations, may be worth a brief review.

The fundamental experiments have been made on anæsthetized cats and dogs. The carbon dioxide content of the blood was increased by inhalation of carbon dioxide and decreased by forced breathing (hyperventilation). The most striking effect is on the arterial blood pressure, increase of carbon dioxide causing a rise of pressure, decrease a fall. This effect is due to the direct action of carbon dioxide on the vasomotor centre, the normal 'tone' of which is dependent on the continual stimulus of carbon dioxide. In addition, carbon dioxide has a peripheral action on the capillaries causing dilatation, which tends to cause a fall of blood pressure; normally, however, the central effect predominates and the net result is a rise.

In anæsthetized animals, increase of carbon dioxide causes slowing of the heart (sometimes there is a transitory initial acceleration). The slowing is partly reflex from the rise of blood pressure, but is mainly due to the direct action of carbon dioxide on the cardio-inhibitory centre. Conversely, hyperventilation causes acceleration of the heart.

Increase of carbon dioxide causes a considerable increase in the stroke volume of the heart, so that, despite the reduced heart-rate, the total output per minute is increased. The increase in stroke volume is due to increased diastolic filling, and it was thought that this was simply due to the rise of venous pressure which usually occurs. Dr. Mathur has shown, however, that the increase in cardiac output can occur quite independently of the rise of venous pressure, and he believes that carbon dioxide has a direct action on the heart-muscle, increasing the diastolic relaxation of the ventricle. When the carbon dioxide is reduced by hyperventilation, the cardiac output falls owing to reduced diastolic relaxation of the ventricle. He emphasizes this beneficial action of carbon dioxide on the heart in promoting diastolic relaxation and so allowing greater filling, which, owing to the intrinsic properties of cardiac muscle, automatically gives rise to increased output. He believes, further, that this increased cardiac output is an important contributory factor to the rise of blood pressure.

Previous workers had usually reported a reduction of cardiac output following administration of carbon dioxide. Dr. Mathur found that the increase of output with carbon dioxide was only to be obtained during the first hour or two of the experiment, while the heart was 'fresh'; after several hours of anæsthesia, the heart became 'stale' and then carbon dioxide caused a reduction of output. This seems to explain the discrepancies in the reported results. It seems rather surprising that an increase of carbon dioxide above the normal level should actually improve the efficiency of the heart. The general outcome, however, is quite clear, that a normal level of carbon dioxide in the blood is necessary for the maintenance of normal vasomotor tone, normal heart-rate and normal diastolic relaxation of the heart; these must all be reckoned as beneficial effects.

The general interpretation of these cardio-vascular responses to an increase of carbon dioxide is that the circulation-rate is increased in order to hasten removal of carbon dioxide. The slowing of the heart is, therefore, somewhat surprising; an acceleration would seem more appropriate. Dr. Mathur regards the slowing as a protective device, enabling the heart to conserve its energy so that it can survive longer under asphyxial conditions. It remains to be seen, however, if the slowing is a general phenomenon; perhaps it only occurs under anæsthesia. In man, inhalation of carbon dioxide always causes acceleration. In the whole animal the problem is complicated by the fact that the increased respiratory movements cause changes in the venous return which reflexly affect the heart-rate and the output. It is very difficult to disentangle these effects from the direct effects of carbon dioxide, and the whole problem requires further analysis. O. A. TROWELL.

# ECONOMIC EXPLOITATION OF EUROPE AND ITS CONSEQUENCES

THE analysis of German economic policy for Europe which was issued by the Royal Institute of International Affairs in March 1941 under the title "Europe Under Hitler: In Prospect and Practice" has now been followed by a further study, "Occupied Europe: German Exploitation and its Post-war Consequences"*. The measure of the change in the situation during the three years may be seen in the structure of the two booklets. The first emphasized the two parts of German economic policy: a short-term plan for the duration of the War; and a long-term plan for the permanent organization of Europe. The first booklet discussed both, but while the first part of the new study examines Germany's domination over occupied Europe and the mobilization and exploitation of its resources up to the autumn of 1943, the implications of a permanent German 'New Order' are no longer considered. Instead, the second part dealing with the post-war period discusses some of the problems to be faced during and after liberation, and in a couple of dozen pages gives a lucid account of the implications of German domination and the conditions which any plans for rehabilitation and reconstruction must seek to meet.

The first part of the booklet points out that, whether by military or political measures, the Germans have bereft all the occupied countries of their freedom. All resources, both material and human, have been mobilized for the benefit of Germany and often transferred to Germany, while under the

* "Occupied Europe: German Exploitation and its Post-War Consequences. Pp. 75. (London: Royal Institute of International Affairs, 1943.) 1*s.* 6*d*

blockade and war conditions, even the neutral countries can only maintain their economic life by diverting a high proportion of their normal trade to Germany or to countries under her domination. Sweden, for example, is now entirely dependent for supplies of coal, and for many other commodities, on imports from Germany, and in return continues to export to the Reich high-grade iron ore and other materials urgently required for the German war economy. Continental Europe has been taking about two-thirds of Sweden's export trade, of which Germany receives some half. Again, Germany has been forced by events to concentrate more on short-term plans for the mobilization of resources for their immediate effect than on long-term policy for the 'New Order', and the factors which govern the economic policy for any territory are the current requirements of the German war machine and the need for the maintenance and security of the German home front.

The fundamental difficulty in Germany's war economy problems is a shortage of man-power. The social and industrial consequences of the German exploitation of the human and material resources of the occupied countries, and the resultant food situation, need only to be pondered to realize how grave are the implications for the post-war period. The pamphlet, however, also directs attention to the enormous demand for fuel and power created by Germany's war economy, together with the shortages resulting from the British blockade of overseas supplies of oil and also raw materials. The extensive development of substitute raw materials and the power requirements of industry, as well as the demands of transport and the armed forces, have placed a tremendous burden on available supplies of coal, wood and electricity. The manufacture of substitutes is estimated to demand a third of the total output of electricity in the Reich and about one-fifth of the output of coal. Moreover, while Germany has gained control of all the main sources of coal in Europe, she has apparently been unable appreciably to increase production. The whole transport system under the control of Germany is now suffering from severe strain, motor transport has had to be cut to the barest minimum; sabotage is an increasingly important element and the railways of occupied Europe are being taxed and drained to the limit regardless of ultimate or immediate deterioration.

Agricultural production is being adjusted to serve Germany's special needs, with compulsory delivery at stable prices and the control of harvesting, enforced by heavy penalties. The long-term policy has attempted to increase production in the low-yield areas with adjustment in Western countries in consequence of the shortage of feeding stuffs, which has involved a compulsory decrease in draught animals, cattle, pigs, and other livestock. This policy has not conduced to willing co-operation from farmers in the Scandinavian countries and the Netherlands, and many factors have operated against the policy of increasing the production of oil seeds in south-eastern Europe. Improved weather conditions in 1943 more than compensated for shortage of labour, fertilizers and equipment. The yields of crops increased and the position as regards vegetable oils improved. With regard to industrial raw materials, in spite of the opening of mines and exploitation of resources, the lack of certain raw materials is still a problem which must be intensified by the loss of the manganese resources at Nikopol and bombing policy in the west, with the destruction of molybdenum mines in Norway, for example. In the U.S.S.R. the withdrawal of practically all skilled labour by the Russians, and their 'scorched earth' policy, made it difficult for the Nazis to execute plans for rapid economic development, and apart from manganese the gain in raw materials appears to have been small.

The review of the mechanism of economic exploitation adopted by the Germans in accordance with their policy of organizing the maximum development of essentials in their own interests draws largely on the Inter-Allied Information Committee's report, "The Penetration of German Capital into Europe". It is, however, well that it should be widely realized that as the occupied areas are released from enslavement they will be faced not only with conditions of starvation, destitution and probably, in consequence, disease, far more widespread and acute than in 1918–19, but also, in consequence of this exploitation, with far-reaching disintegration and breakdown of their national economies. Unless the British and American peoples fully understand the position, they can scarcely be expected to make the sacrifices that will be involved in their own standard of living.

While it is difficult to forecast the dimension or order of the problem of relief and rehabilitation, the second part of this booklet at least gives a succinct account of the immediate needs which the United Nations Relief and Rehabilitation Administration and similar bodies will have to face, whether the release of occupied areas is gradual or the collapse of Germany sudden. Detailed planning of long-term reconstruction has as yet only reached the stage of initial discussion and investigation, though the pamphlet gives some indication of the factors that may determine it—the development of synthetic and substitute materials, of hydro-electric power and transport, agricultural policy and adjustments; but the provision of relief and rehabilitation will be, as Sir Frederick Leith-Ross has pointed out, the test of the capacity of the United Nations to rebuild a more prosperous world and to give freedom from want in their territories. The Royal Institute of International Affairs in this pamphlet has done something to make plain what this will involve in terms of the continuance in the immediate post-war period of the shortages and rationing, controls and restrictions of war-time.

## THE NUCLEOLUS

THE nucleolus was first figured in 1781 as a spot in the centre of a round or oval body (the nucleus) in epithelial cells of the eel. Since then it has been described in the nuclei of almost every type of plant and animal cell. Many interpretations were offered of its nature and function. Perhaps the view most widely accepted until very recent years was that it acted as a focus for the elaboration of chromatin which passed from it to the chromosomes as they developed through the prophase. During the last decade the use of Feulgen's reaction for the staining of nuclei has given a new impetus to the study of the nucleolus. This stain showed that at no stage does the nucleolus contain chromatin. Feulgen's stain, together with other modern cytological methods, has made possible the tracing of nucleolar behaviour through all stages of the mitotic and meiotic cycles, and has led to entirely new interpretations of the role of the nucleolus. Most of the recent work has been done on plant cells. Although it is essential that much more attention be given to the nucleoli of animal nuclei, sufficient has been accomplished to show that plant and animal nucleoli are similar in essentials.

Three important discoveries during this century have determined the trend of modern research on the nucleolus. In 1912 were first seen, in Galtonia, chromosomes with satellites to which the nucleolus was connected. In 1926, the discovery in meiosis of Lathyrus of the 'nucleolar body' established a definite connexion between the chromosomes and the nucleolus. This body was a globule within the nucleolus to which the 'continuous spireme' was attached in prophase. With the methods then in use chromatin thread and nucleolar body stained similarly. In 1934, it was found that a 'nucleolar organizer' existed at a fixed point on certain chromosomes of maize. It was not of necessity visible as a separate entity but the nucleolus always arose in telophase at this point.

It is now well established that nucleoli are produced from the chromosomes in the telophase of mitosis. Each nucleus contains at least one pair of nucleolar chromosomes and each of the pair produces a nucleolus. The nucleolar chromosomes are frequently the sex chromosomes. Each of the pair has attached to it, by a very fine thread, a satellite which may be exceedingly small or may be a globular body as wide as the chromosome. The nucleolar organizer is usually at the tip of the chromosome at the point of attachment of the satellite thread; but it may be placed farther back at a secondary constriction. Suitable technique shows the origin of the nucleolus to consist of two minute granules, one on each strand, which stain similarly to the chromosome sheath. They may be formed from the material of this sheath, for it disappears as the granules increase in size. Any two nucleoli which touch because of growth or due to chromosome movement within the nucleus merge together. By the following prophase all are usually fused into a single body to which all the nucleolar chromosomes for some time remain attached. They break away when the nuclear membrane breaks down in late prophase and the nucleolus passes into the cytoplasm and disappears. A previous decrease in size of the nucleolus suggests that it may contribute material to the sheaths of the newly differentiated chromosomes.

The presence of several nucleoli at telophase, all of which fuse into one body before prophase, has been frequently described, but only recently has it been realized that the number of nucleoli is constant within any one species and is probably of as great phylogenetic importance as the number of chromosomes. Diploids may have one or more pairs of nucleolar chromosomes, and primary and secondary polyploids show a corresponding increase in their numbers of nucleoli countable in early telophase.

So much data on the nucleolus has accumulated that, although he gives eight pages of references, in his monograph "Nucleoli and Related Nuclear Structures"*, Prof. R. Ruggles Gates is able to quote only the more important work. Much of the earlier research obviously needs amplification or repetition using more modern technique. Gates deals briefly with the historical aspects of the subject, and then ably summarizes and critically reviews the more important recent work. As well as discussing the nucleolar cycle in mitosis in the normal higher organism, he discusses and brings into line the nucleolar behaviour in some lower organisms, he tells of related structures induced by pathological conditions and also discusses nucleolar budding. He refers to variations in nucleolar size due to physiological and other causes and evaluates the work on the chemical composition of nucleoli, much of which is at present inconclusive. He examines the relationships of the nucleoli with the chromosomes, the satellites and satellite threads. Gates suggests that the nucleolus may be of genetic and developmental significance for, after being in intimate association with genic material, at metaphase a large part of it is dissolved into the cytoplasm. Finally, he stresses the phylogenetic importance of the numbers of nucleoli, asking that future reports of chromosome numbers should include a determination of the number of chromosomes with satellites or secondary constrictions and the number and sizes of the nucleoli in somatic telophase. F. M. L. SHEFFIELD.

* Gates, R. Ruggles, "Nucleoli and Related Nuclear Structures" *Bot. Rev.*, 8, 337 (1942).

## THE HYGIENE OF THE EIGHTH ARMY IN NORTH AFRICA

LIEUT.-COLONEL H. S. GEAR, of the South African Medical Corps, has described the hygiene aspects of the El Alamein victory won by the Eighth Army in North Africa (*Brit. Med. J.*, March 18, 1944). "The Germans," says Colonel Gear, "must regretfully realize that their neglect" of sanitation "contributed seriously" to their defeat. Some 40–50 per cent of the German and Italian front-line troops were suffering from dysentery and diarrhœa, while the Eighth Army, thanks to the efficient methods outlined by Colonel Gear, was "probably as fit mentally and physically as any army has ever been".

The supply of rations to such an army, and of purified water to the quantity, during the preparatory phases at any rate, of one gallon a day for every man, must have been tremendous problems in themselves. The battle ration was reorganized, but, when the advance began, the rapid movement and dispersal of units created serious problems of cooking and refuse disposal. Each vehicle adopted the practice of preparing its own meals, a practice which resulted in feeding out of tins, waste of rations and the scattering of food remains over large areas, with the resultant encouragement of the breeding of flies. Mobile cooking lorries were therefore instituted, which carried hot, properly cooked meals forward to fighting men. It was found that continuous training and propaganda were necessary to ensure that all units had good cooks, proper company cooking arrangements and a sense of cooking hygiene and sanitation.

The water supply is always a vitally important problem of war in what Colonel Gear modestly calls "warm climates", because so many water-borne diseases exist which can rapidly destroy the efficiency of any force. El Alamein was supplied by water pipes laid from Alexandria by British Army engineers. These carried purified water for fifty miles into the desert and to points within a few miles of the front line. This was truly a remarkable feat. But, when this supply was left behind, the captured water points, polluted by the enemy with oil, dead bodies and filth of all kinds, had to be made fit for use. When these in their turn were left behind, water was carried in tins and captured enemy water-containers. Older men who experienced the chlorinated water of the War of 1914–18 will realize what lies behind the sober account of these vital matters given by Colonel Gear. They will also be interested to hear that the sun topee was abandoned without bad results. Perhaps they will remember the friends who visited their Mesopotamian messes and next day were dead from the sudden 'effects of heat'. They will be glad to hear that no cases of heat- or sunstroke or of other direct effects of heat were reported in the Western Desert. Even the tanks did not require special air-conditioning devices to protect their occupants from the effects of heat. Sun-glasses were not a general issue to the troops and Colonel Gear argues that they may actually be harmful, because people who get used to them in the relatively non-glaring atmosphere of, say, Cairo, may suffer intensely when they go to the white sand areas of the Western Desert.

It is a well-deserved tribute that Colonel Gear pays to the hygiene officers and men of the Eighth Army. Their work was not dramatic. Its daily details involved matters to which many adopt an ostrich attitude; it was hard slogging against difficulties which can only be overcome by meticulous attention to detail and insistence on discipline. Apart from the maintenance of efficient sanitation among the British forces, the Hygiene Corps had to supervise the Bedouin and other peoples who fled to El Alamein and became such a sanitary danger behind the British lines that they had to be removed. They were faced, like their predecessors at Mosul and other places on the Tigris during 1914–18, with the task of cleaning up the gigantic heaps of refuse and filth left behind by the retreating enemy. But they had the advantage of wise direction and an efficient sanitary organization.

It is time that a just tribute be paid to these men, who guarded, by their unremitting care, the lives and health of the fighters who saved Egypt and India. Without them the British armies might have suffered the fate of the Germans and Italians. Like the Royal Army Service Corps, the Royal Army Ordnance Corps and all the other supply services, the Hygiene Corps provided an essential part of that basis of efficiency without which the best of fighting men cannot succeed.

G. LAPAGE.

## FOREST PRODUCTS

ATTENTION has been directed in NATURE from time to time to the value and possible changes in the form of utilization of timber which plywood, one of the processes of lamination, renders possible. In an address before the Royal Society of Arts entitled "Forest Products", delivered on November 22, 1943, Mr. W. A. Robertson, director of the Forest Products Research Laboratory, dealt with the results of research and the future possibilities (*J. Roy. Soc. Arts*, 92, Jan. 21, 1944). Great Britain will have to depend for its supplies of soft woods on itself (a negligible factor for some years to come), the Continent of Europe and on Canada.

As regards the forests of the British Empire, with the exception of Canada and Newfoundland the bulk lie in the tropics or sub-tropics, starting in the west with British Honduras and Guiana, on to the Gold Coast and Nigeria, thence through Uganda, Kenya, Tanganyika across to India, Burma and Malaya, and one large forest block in the south of Australia. The total area of these tropical forests is very large. The present area accessible to exploitation is estimated at 330,000 sq. miles, which is less than the area of softwood forests in Canada (more than 550,000 sq. miles). The two types are not comparable. Whereas the softwood coniferous forests are mostly pure (that is, of one species only) or at most two or three, in the tropical forests hardwoods prevail; species occur of varying degrees of hardness from very soft to the hardness of iron, and thirty or more species may be mixed together in a forest. To date but a few species have been in demand in Great Britain, and only a slightly larger number by the inhabitants of the countries in which the forests exist. Difficulties of commercial extraction under such conditions can be appreciated, also the failure to develop new markets owing to the mistaken policy of past administrations in insisting that the habits of the population, whether harmful to the forests and countryside generally and to a progressive development of the people concerned, should not be interfered with.

So far as difficulties of extraction are concerned, Mr. Robertson points out that the change is coming and that the new methods of use should permit of a much larger utilization. The first stage, he points out, is the change in the introduction of lamination usually associated with the term 'plywood', though, he says, lamination means much more than this. He explains it as follows in popular terms: "By the application of lamination we give up having to rely on the properties of chunks of timber as nature has given it to us with many defects and difficulties, and by arranging the timber in layers we balance defects with clear timber, we set off the weakness of timber in one direction by its strength in another and reduce the dimensional changes, i.e., the shrinkage and swelling. Thus a beam of 6″ × 3″ made up of ½ inch thick laminations can be about twice as strong as the same section cut out of solid timber of the same quality and a sheet of 3-plywood is 1½ times as strong in shear as a board of the same thickness, while its shrinkage and expansion is only one-thirteenth of the plain wood across the grain".

The possible methods of utilization thus opened out will permit of the elimination in some cases, or the distribution in others, of inevitable defects, so that they shall not occur at places of maximum stress where their weakening effect would be most felt. It may be pointed out that the application of this contention is not universal, as the oak timbers in the roof of Westminster Hall and many churches and old barns in the south of England will prove. But it is beyond dispute that with the ever-increasing demand for timber products, the new methods will permit of the use of lower quality timber "in the lightly stressed parts of an assemblage and reserve the best quality for the highly stressed regions". Finally, it permits of the utilization of short lengths of timber, the most fruitful source of waste in the past. As Robertson says, it is no secret that lamination has allowed the survival of the wooden aircraft, for without it the spars of the necessary length would have been unprocurable. Finally, it is pointed out that between 1932 and 1937 the imports of plywood into Great Britain increased from roughly 5 million cubic feet a year to 13 million, and that several of the main producing countries had reached the limits of their home-grown resources; the importance of this change in the use of wood is therefore self-evident. The more so, as has already been pointed out in NATURE, that it should enable secondary industries to be developed on the countryside in the Colonies.

Mr. Robertson also dealt briefly with the possibilities opening out in the chemical utilization of wood, in which considerable investigations have been carried out in America.

# FORTHCOMING EVENTS

### Monday, June 5

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 8 p.m.—Mr. J. A. Steers: "Coastal Preservation and Planning".

### Wednesday, June 7

PHYSICAL SOCIETY (COLOUR GROUP) (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2), at 4.30 p.m.—Dr. W. D. Wright: "The Munsell System: a Review of Recent Work carried out by a Sub-Committee of the Optical Society of America on the Spacing of the Munsell Colours".

### Friday, June 9

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Sir Harold Spencer Jones, F.R.S., and Mr. R. T. Cullen: "Preliminary Results of Tests of and Observations with the Reversible Transit Circle of the Royal Observatory, Greenwich"; Sir Arthur Eddington, F.R.S.: "The Recession-Constant of the Galaxies".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Mr. Michael Graham: "Men and Science in the Sea Fisheries".

### Saturday, June 10

INSTITUTE OF PHYSICS (ELECTRONICS GROUP) (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Discussion on "Some Aspects of High Vacuum Technique, viz., High Vacuum Gauges and Glass Manipulation" (to be opened by Dr. M. Pirani and Dr. B. P. Dudding).

# APPOINTMENTS VACANT

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

GRADUATE to take SCIENCE, TECHNICAL DRAWING and MATHEMATICS in the Newcastle Junior Technical School of Building Crafts—The Director of Education, City Education Office, Northumberland Road, Newcastle upon Tyne, 2 (June 8).

ASSISTANT MASTER qualified to teach PRACTICAL PLANE and SOLID GEOMETRY for Engineering and Building Courses in the Plymouth Junior Technical School for Boys—The Director of Education, Education Offices, Cobourg Street, Plymouth (June 8).

LECTURER (man or woman) IN GEOGRAPHY AND MATHEMATICS—The Principal, Dudley and Staffs. Technical College, Dudley (June 9).

ASSISTANT LECTURER (temporary) IN MATHEMATICS, and an ASSISTANT LECTURER (temporary) IN GEOGRAPHY—The Secretary, King's College, Strand, London, W.C.2 (June 9).

DEMONSTRATOR (man or woman) IN THE PHYSIOLOGY DEPARTMENT—The Warden and Secretary, London (Royal Free Hospital) School of Medicine for Women, 8 Hunter Street, Brunswick Square, London, W.C.1 (June 9).

ENGINEER AND MANAGER of the Manchester Waterworks Department—The Secretary, Waterworks Department, Town Hall, Manchester 2 (June 10).

INSPECTORS (temporary) by the Board of Education (1) MECHANICAL OR ELECTRICAL ENGINEERING (Reference No. C.2125A), (2) AERONAUTICAL ENGINEERING (Reference No. C.2124A)—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting the appropriate Reference No.) (June 10).

TEACHERS (two, temporary) with qualifications in MATHEMATICS and PHYSICS for Service Training Courses (approximately Intermediate Science standard)—The Clerk to the Governors, South-West Essex Technical College and School of Art, Forest Road, Walthamstow, London, E.17 (June 10).

OFFICER WITH THE TECHNICAL DEVELOPMENT COMMITTEE of the Holland War Agricultural Executive Committee—The Principal and Executive Officer, Agricultural Institute, Kirton, Boston, Lincs. (June 10).

GRADUATE ASSISTANT IN ENGINEERING (full-time) at the Llanelly Mining and Technical Institute and Junior Technical School—The Director of Education, Education Department, County Hall, The Castle, Carmarthen (June 10).

ASSISTANT MASTER (Graduate or non-Graduate) with special qualifications in BUILDING SUBJECTS, MATHEMATICS and SCIENCE, at the Hinckley Technical College—The Director of Education, County Education Office, Grey Friars, Leicester (June 10).

LECTURERS to take the following subjects for Evening Classes up to Matriculation standard: ELEMENTARY MATHEMATICS, GEOGRAPHY, CHEMISTRY, PHYSICS, BIOLOGY, LOGIC—The Director of Education, The Polytechnic, Regent Street, London, W.1 (June 12).

SENIOR LECTURER IN BIOLOGY—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham, Essex (June 12).

GRADUATE ASSISTANT FOR CHEMISTRY AND MATHEMATICS at the School of Building of the East Ham Technical College—The Secretary for Education, Education Office, Town Hall Annexe, Barking Road, East Ham, London, E.6 (June 12).

TEACHER (woman, full-time) OF HOUSEHOLD SCIENCE AND HYGIENE in the Domestic Sections of the Day Trade School and in Part-time Day Classes of the Cambridgeshire Technical School—The Education Secretary, Shire Hall, Cambridge (June 12).

LECTURER IN PSYCHOLOGY AND PRINCIPLES OF EDUCATION—The Principal, Gipsy Hill Training College, at Bankfield, Bingley, Yorks. (June 12).

DOCKYARD MANAGERS for service in the Sudan (must be fully trained Marine Engineers holding University engineering degrees, or A.M.I.Mech.E. or A.M.I.N.A.)—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.2148A) (June 14).

CHAIR OF NATURAL PHILOSOPHY, United College, St. Andrews—The Secretary, The University, St. Andrews (June 15).

ASSISTANT HYDROGRAPHIC SURVEYORS by the Kenya Government Public Works Department—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E.904A) (June 17).

ENTOMOLOGISTS in the Medical Department of Uganda, Northern Rhodesia, and the Tanganyika Territory, for general entomological work; with special emphasis on the investigation of tsetse fly and mosquito problems in the field as well as in the laboratory—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. F.2421A) (June 17).

HEAD OF THE PHARMACY DEPARTMENT—The Registrar, Technical College, Sunderland (June 17).

INSTRUCTOR IN PRODUCTION ENGINEERING—The Registrar, Technical College, Sunderland (June 17).

LECTURER IN ENGINEERING in West Africa—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E.836A) (June 21).

PHYSICIST for essential War work (work would include experience in various research departments of a North London firm specializing in optical instruments for scientific and industrial research and control)—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. A.518XA) (June 21).

COMBUSTION AND RESEARCH ENGINEER by large organization, with headquarters at Glasgow—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.2031XA) (July 1).

ASSISTANT LECTURER IN ENGINEERING—The Registrar, The University, Manchester 13 (July 1).

ASSISTANT MECHANICAL ENGINEER for the electrical branch of the Nigerian Government Public Works Department—The Secretary, Overseas Manpower Committee, Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. 1931).

TEACHER OF SCIENCE (particularly CHEMISTRY) AND MATHEMATICS, and a TEACHER OF MATHEMATICS AND ENGINEERING SUBJECTS, at the Slough Junior Technical and Commercial School—The Secretary for Education, County Offices, Aylesbury, Bucks.

LECTURER (man or woman, temporary) FOR PHARMACEUTICAL SUBJECTS to Ph.C. standard—The Principal, Birmingham Central Technical College, Suffolk Street, Birmingham 1.

LECTURER IN GEOGRAPHY—The Registrar, The University, Reading.

MATHEMATICAL MASTER OR MISTRESS—The Acting Headmaster, Perse School, Cambridge.

LECTURER IN GEOGRAPHY (Honours Degree and special interest in human side of Geography essential)—The Principal, Furzedown Training College, at 29 Corbett Road, Cathays Park, Cardiff.

LECTURER (full-time) IN MECHANICAL ENGINEERING, and a MASTER to teach SCIENCE and MATHEMATICS in the Junior Technical School for Boys—The Principal, Wimbledon Technical College, Gladstone Road, Wimbledon, London, S.W.19.

# REPORTS and other PUBLICATIONS

*(not included in the monthly Books Supplement)*

### Great Britain and Ireland

Institution of Electrical Engineers. Report of the Council for the Year 1943–1944, presented at the Annual General Meeting on the 11th May 1944. Pp. 12. (London: Institution of Electrical Engineers.) [45

Board of Education. Principles of Government in Maintained Secondary Schools. (Cmd. 6523.) Pp. 10. (London: H.M. Stationery Office.) 2*d*. net. [55

Scientists and Production. Pp. 8. (London: Association of Scientific Workers.) 3*d*.

Report on the Work of the National Organisers of the Association of Scientific Workers. Pp 16. (London: Association of Scientific Workers.) [55

### Other Countries

Transactions of the San Diego Society of Natural History. Vol. 9, No. 34: Foraminifera from the Type Area of the Kreyenhagen Shale of California. By J. A. Cushman and S. S. Siegfus. Pp. 385–426 + plates 14–19. Vol. 9, No. 35: Two New Wrens and a New Jay from Lower California, Mexico. By Laurence M. Huey. Pp. 427–434. Vol. 9, No. 36: A New Race of the Rusty Sparrow from North Central Sonora, Mexico. By A. J. van Rossem. Pp. 435–436. Vol. 9, No. 37: A New Flea of the Genus Ceratophyllus. By G. F. Augustson. Pp. 437–438. Vol. 9, No. 38: A Pleistocene Tortoise from the McKittrick Asphalt. By Loye Miller. Pp. 439–442. (San Diego, Calif.: San Diego Society of Natural History.) [124

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