Vol. 156, No. 3972 SATURDAY, DECEMBER 15, 1945 ONE SHILLING & SIXPENCE

NATURE

No. 3972 SATURDAY, DECEMBER 15, 1945 Vol. 156

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Editorial and Publishing Offices
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ST. MARTIN'S STREET, LONDON, W.C.2.
Telephone Number: Whitehall 8831
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T. G. Scott & Son, Ltd., Talbot House, 9 Arundel Street, London, W.C.2
Telephone: Temple Bar 1942
The annual subscription rate is £4 10 0, payable in advance, Inland or Abroad.

Registered as a Newspaper at the General Post Office

HIGHER TECHNOLOGICAL EDUCATION IN BRITAIN

THE need for a considerable expansion of the research effort of Great Britain is now generally accepted, and on every hand industrial concerns, industrial research associations, and government departments are taking steps to increase their research facilities. These efforts are being made on the assumption—and it must remain an assumption for some time to come—that there will become available more men and women capable of conducting research successfully. Granted this, however, those of our national problems which demand for their solution more scientific and technical research will in fact be solved only if there become available also more men and women capable of translating the results of research speedily and efficiently through the various stages of development into large-scale production.

It has not perhaps been sufficiently recognized that notwithstanding the paucity, in quantity, of the pre-war research effort of Great Britain relative to that of certain other countries, we did not compare unfavourably with any in the production of new ideas and the practical demonstration of new principles. Our deficiency lay in the ability to engineer our scientific and technical achievements on an adequate scale. Those who say that before doing more research we ought to use more effectively what has been done already are not speaking nonsense; they are giving warning of a danger which we shall be wise not to ignore in the years ahead.

The scope and difficulty of the whole problem of educating and training the technical personnel required by industry in these connexions has increased considerably with the rapid expansion and growing complexities of scientific knowledge and technical development. This problem has received much attention in Britain during recent years from the professional bodies concerned, and a report on the matter by a Committee appointed by the Government in April 1944 under the chairmanship of Lord Eustace Percy has been keenly awaited*. The terms of reference of this Committee were as follows: "Having regard to the requirements of industry, to consider the needs of higher technological education in England and Wales and the respective contributions to be made thereto by Universities and Technical Colleges, and to make recommendations, among other things, as to the means for maintaining appropriate collaboration between Universities and Technical Colleges in this field".

In its report, this Committee states that its original intention had been to make successive reports on the educational provision required to meet the needs of various industries, but that in view of the magnitude of the problem it has limited itself to a consideration of the field of engineering, and has used this to illustrate the form of organizing body which it recommends should be established. It has

* Ministry of Education. Higher Technological Education. Report of a Special Committee appointed in April 1944. Pp. 32. (London: H.M. Stationery Office, 1945.) 6*d*. net.

further limited its consideration to the 'professional' category of engineer. These restrictions are somewhat unfortunate, for much might have been gained from a comparison of the needs and experiences of the engineering and chemical industries, and also since the Institutions of Electrical and Mechanical Engineers have been laying stress on the rapidly growing importance of a grade of personnel lying between the professional and craft grades. This grade comprises men engaged as technical assistants in research and development, designer-draughtsmen, testers, inspectors, etc., for whom the technical colleges have thus far made little specific provision. The industrial demand for better trained men of these types is urgent, and the technical colleges have no more important function to discharge.

Hitherto, the main avenues to professional recognition in engineering in Britain have been degree courses at the universities and part-time national certificate courses at the technical colleges. The total pre-war output of these courses was about two thousand a year, of whom about one-third were university graduates in engineering and a small proportion holders of higher national diplomas gained by two years full-time attendance at a technical college. So late as 1937–38, four-fifths of the Higher National Certificate students received their instruction in evening classes, a system which is now generally recognized as wholly inappropriate to the standard demanded of the professional engineer.

During the War, the annual output of professionally qualified engineers has been raised to about 2,700, and the Committee estimates that this figure must be maintained. The present capacity of the university departments of engineering in Britain is stated to be about 1,200 a year, leaving some 1,500 to be accommodated by the technical colleges. The report divides the latter into three groups : 1,000, who will attain the Higher National Certificate via part-time courses, but on a day-time and not an evening basis ; 150, who it is assumed will elect to work, as in the past, for a London external degree (although the system of external degrees is regarded by the Committee as an anomaly) ; and the remaining 350 for whom it is suggested specially planned courses should be provided.

Regarding these latter courses, the Committee states : "we would insist that such courses should be directed to the development of the highest level of the teaching of the art of technology, based on a sufficient scientific foundation. Such courses should have a status in no way inferior to the University type of course ; they should require equal ability in the student ; and they should afford a preparation for the most advanced post-graduate courses. But they will be different from University courses ; and their development should not, therefore, be hindered or deflected by University affiliations or by arrangements for the grant of University degrees whether by existing universities—or, as some of our witnesses have suggested to us—by some new national technological university created purely for purposes of examination and standardization."

The provision of these special higher technological courses would be a function of a strictly limited number of technical colleges, to be called 'Colleges of Technology'. In addition, these colleges would be expected to cater for a large volume of part-time work leading to Higher National Certificates and like qualifications, and to develop postgraduate courses in special branches of technology "intended generally for their own graduates or for graduates from Universities, and for men who have been in industry for some time". The colleges of technology would be subject to the ultimate control of the providing local authority in matters of finance and general policy ; but in order to ensure maximum co-ordination of effort with adjacent universities and technical colleges it is recommended that regional advisory councils and regional academic boards of technology be set up, themselves co-ordinated in a 'National Council of Technology'.

The need for a number of the larger technical colleges, acting in close collaboration with the universities, the professional institutions and local industry, to provide both full- and part-time postgraduate courses in the branches of technology relevant to their respective regions cannot be over-emphasized. Certain regional advisory councils for higher education are already engaged on this matter, and their efforts would be strengthened considerably by the formation of a national co-ordinating body such as is suggested. With this aim of the recommendations there will be general agreement ; but there will be differences of opinion on the case which the Committee has attempted to make for the establishment of a new type of undergraduate course, whatever be the title, B.Tech., Diploma in Technology, associate of the Royal Colleges of Technology, by which, different groups in the Committee suggest, success in the course might be rewarded.

It is stated that failure to meet the demands of (the engineering) industry in the past have been due partly to deficiencies in the courses of education and training. Yet the Committee's analysis of these deficiencies does not extend beyond such tentative statements as "University undergraduate courses may have been too short and too specialized", and "in courses for the Ordinary and Higher National Certificates there may have been too little of that early scientific grounding which is as necessary to the art, as it is to the science, of engineering or of any other branch of technology". The Institution of Electrical Engineers has not been so hesitant in its comments on the present inadequacy of the scientific foundation afforded by both these types of course, and has asked that the deficiency be corrected in both cases without delay. It can be corrected in National Certificate courses, of course, only on the basis of a general replacement of evening by day-time classes, and this arrangement the Percy Committee has in mind for the thousand engineers who are to attain professional status through this channel.

The Committee has not made clear enough how the new courses, intended to cater for 350 persons a year, are to differ from the improved versions of the old, which are to serve for the remaining 2,350 of the same age-group. They are to emphasize the art of engin-

eering, "in which aspect it is concerned with the special application of general principles to particular problems of production and utilization", but *not neglect* the science, "in which aspect it is concerned with general principles which are valid for every application"; and they are to require equal ability to that required for success in a university degree course. These are vague statements, and there are many others. The suggestion of an undergraduate course dealing with the production side of engineering is not new, but thus far no serious attempt has been made to define a possible content or to assess the intellectual discipline which such a course would afford. These matters should have been dealt with more fully, and must be clarified before a reliable assessment of the proposal can be made. The trend of informed opinion would seem, however, to have been in the reverse direction.

The crux of the whole matter is that the production of the high-grade technologist requires a longer period than we have been prepared to devote to it, and to evade this issue will be fatal. The complex problems with which he is now faced demand that his training shall not merely *not neglect* science—by which should be understood the basic subjects of chemistry, physics and mathematics—but shall aim increasingly at broadening his appreciation of it, and inspire the realization that the impact of science on technology is a continuous and expanding process. Any action therefore which does not facilitate a tightening of the present inadequate link between the two is retrogressive. For this reason the suggestion that colleges of technology be set up separately from the universities and their faculties of science requires the most careful consideration. 'Colleges of Science and Technology' as an integral part of the university system appear a more desirable goal, and would permit a more ready solution of the highly important problems of adjustment and of student transfer between universities and technical colleges to which the report refers.

The scheme envisaged is superficially attractive; the advantages of full-time over part-time courses at the educational stage under consideration are unquestionable, while the administrative problems involved in implementing the recommendations would be minimal. This is no doubt an important consideration in times of emergency; but urgent as the problem may be, we shall be wise to consider before action is taken whether the courses and arrangements proposed are likely to produce the high-grade technologists required.

Other recommendations contained in the report are extremely welcome, and it is to be hoped that they will be acted upon without delay. Thus, in stressing the importance of a much increased flow of able boys from part-time to full-time courses of study, and referring to the manner in which this has been facilitated academically by the institution in some universities of an industrial matriculation, the Committee recommends an extension of the national system of scholarship awards to make this transfer more possible financially. It also recommends the institution of a campaign to increase the prestige and attractiveness of the technical professions; the establishment of a centre for the postgraduate study of industrial administration; and more positive arrangements to enable teachers of technology to keep abreast of industrial development. There is, of course, equal need for them to keep abreast of scientific development; and this, in itself, is a powerful reason for securing the closest possible merging of their departments with university departments of science.

INTERPRETATION OF FANTASY AS A CLINICAL TECHNIQUE

Controlled Projection (1944)

A Standard Experimental Procedure. Arranged by John C. Raven. Pp. 54. (London: H. K. Lewis and Co., Ltd., 1945.) 12*s*. 6*d*. net.

RECENT developments in projective technique offer a new approach to the mind, the exploration of which is just beginning. The underlying concept of projection (attributing our own 'qualities' to others) owes its origin to Freud. It was postulated to explain the origin of delusions of persecution and ideas of reference in paranoia. Freud thus identified a distinctive mental process of which we had only been vaguely aware. Many proverbs embody the belief that projection enters into daily intercourse. Folk-knowledge recognizes that in judging others we judge ourselves, that in condemning or condoning the actions of others we betray our own private inclinations. In the narrower sense in which Freud understood it, however, projection is a mechanism of defence employed, as an alternative to repression, with the aim of ridding the mind of an intolerable burden of aggression or guilt. Some recent experiments have thrown further light on these alternative *extra-* or *intro*-punitive processes.

Projection helps to shape our relationships with the outer world. We 'infer' from the dim or clear awareness of our own state of mind the state of mind of another person. It is not inference in the logical sense of inductive reasoning, but arguing by analogy from one particular to another. In Spearman's terminology, projection means educing correlates of our own social attitudes. Taken jointly, projection and correlate eduction are rich in explanatory value. Thus, to take one example, the late Prof. Aveling showed that ideas of cause and effect are generated (educed as correlates) by projecting on to external objects the experience of the self acting upon the organs and limbs of the body.

The recognition that projection plays a major part in the organization of mind has led to its being exploited as a method of penetrating beneath the surface of personality. Indeed, the importance of projective techniques to the psychologist has been likened to that of the X-ray apparatus to the physician. A person's projections can be evoked so as to uncover his innermost impulses, wishes, fears and values. He will interpret an ambiguous social situation in a way which, unknown to himself, will disclose some of the hidden secrets of his mind. In choosing his invective he will most likely dip into his personal inventory of self-condemnation. In forecasting an event on inadequate data he will project himself into his predictions, thus revealing what he *wants* to happen or what he privately fears *might* happen. He may perhaps project his own ignorance into the outside world. This last possibility was well

exemplified by the Press in 1941 when ignorance of Japan's plans in regard to entering the War was projected on to the Japanese rulers, who were believed to be utterly uncertain of their own intentions. Projective techniques are methods of indirectly locating crucial foci of value and conflict. Just as a searchlight, in projecting its beams on to an object, discloses its own location, so the mind by projecting its own wishes, hostility, fears and values, reveals its key centres of activity. Projection is something more than a subjective mental process. It has a social quality inasmuch as it is the main avenue for the mind's interpretation of its environment, human and material. Hence its significance for the study of interpersonal relations.

In England, projective techniques appear to have been first used by Wedeck in 1933 and described by him in a thesis deposited in the University of London library. His object was to inquire whether any 'group factor' existed which implied a special ability for understanding human character and relationships, whether, in other words, the interpretation of facial expression, gestures, social situations, proverbs and the like, required an ability statistically independent of general intelligence (Spearman's '*g*' factor). Wedeck did, in fact, claim to have detected a special ability of estimating character uncorrelated with '*g*'.

The potentialities of projective techniques in the study of personality were first fully appreciated, however, in the United States. H. A. Murray seems to have been early in the field. He set out the methods in his "Explorations in Personality", which attracted curiously little attention in England when it was published in 1937. He had a different purpose in mind; not to find out whether the subjects were good judges of character or not (as measured by some agreed criterion), but to discover their general mental and social orientation.

There is variety in projective techniques. The basic procedure requires that the subject should freely manipulate experimental materials presented to him. Alternatively he may be required to interpret the materials or situation, or he may be asked to carry out certain prescribed acts under observation. The underlying assumption is that the subject will employ the material or situation so as to express his inner values, his mental conflicts, his tendencies, aspirations and imaginary roles. He throws or projects himself into the medium of expression. Such techniques include the Rorschach Test, the Thematic Apperception Tests of Murray (briefly known as TAT), psychodramatic situations, and, in the case of children, play activities. Closely allied procedures are observations of expressive movement, posture, gait and physical activity of almost any kind. The fantasies projected by the subject or patient are not regarded as final indications of the trends in his mind but simply used as working hypotheses to be checked by other criteria. Murray's tests, which are the most important of these devices, were developed at the Harvard Psychological Clinic. In principle similar to the Rorschach Test, the material consists of reproductions of paintings instead of 'ink-blots'. The latest revision of the thematic apperception tests has just been published. Though originally devised for adults of normal intelligence, the tests have also been applied to mental defectives.

The exigencies of war soon determined that, in the interests of military efficiency, methods should be adopted for the assessment of personality in selecting personnel for higher duties. As is now perhaps well known, the important step was taken in 1942 of introducing projective techniques into War Office Selection Board procedure as an aid in selecting candidates on grounds of 'officer quality' or leadership. Here the current tests of intellectual abilities were not appropriate and the new methods were of great help in detecting weakness and strength in the personality structure of candidates, and in the adequacy of their social adjustment. Similar methods are now being employed in selecting candidates for the higher grades of the Civil Service.

Raven's work, stimulated by Murray's efforts and by the 'completion test' of a French investigator, M. Thomas, introduces new steps in testing procedure, part of which is common both to children and to adults. The subject is asked to draw, and while he is drawing, to imagine and describe a series of events. Since he is occupied with two tasks there is little residual energy left for self-observation or self-criticism. There are supplementary tests suitable for adults only. Although best results are obtained with individual administration, an adaptation of the test material is also provided for administration to adult groups.

Raven uses two kinds of material, verbal and spatial simultaneously, and he 'pursues' the subject's fantasies in a number of prescribed directions. There is thus a twofold pursuit of the subject's projections. In the result two distinct yet parallel forms of expression emerge side by side, one oral the other pictorial; each is a check on the other. Both the verbal utterances and the drawings can be systematically followed, step by step, by the experimenter until he is satisfied that his explorations of the subject's personality are as complete as necessary. The materials used are simple and lack any structure of their own.

The ambitious aims of 'projection pursuit' are clearly set out by Raven. It is not facts about the subject's past which are sought, but his interpretation of the events of life, how he organizes his thoughts and actions, how he regards other people and how he imagines other people regard him, what motives he attributes to the actions of others, what are his likes and dislikes, his wishes and judgments, and how, on the basis of these, his character is formed. The sample records given by Raven illustrate (they are not norms) what results are to be expected of children at different age- and ability-levels within the normal range of intelligence. Some records are also given of the projections of adults differing in age, sex and ability.

Several criticisms of the present stage of Raven's techniques come to mind. The methods do not, as is claimed, appear to be appreciably subject to controlled variation. Nor do the results lend themselves at all easily to statistical treatment. Above all, to interpret the records is exceedingly difficult, and practically no guidance is offered on the subject. Raven admits that much has still to be learnt about the most informative questions to be put, about the best methods of pursuit, and about ways of recording the responses. These limitations the reader will readily concede.

The value of the present arrangement of test material lies less in what it achieves than in what it foreshadows. It provides not so much a procedure ready for clinical application as a "method of enquiry suitable for experimental work"; it is therefore as a pioneer effort that the work is to be judged, and the reader must not be too critical, though there is much to criticize.

JOHN COHEN.

SOIL EROSION IN NEW ZEALAND

Soil Erosion in New Zealand

A Geographic Reconnaissance. By Kenneth B. Cumberland. Pp. xi+227+43 plates. (Wellington: Soil Conservation and Rivers Control Council, 1944.) n.p.

A FIVE-YEARS survey convinced the author "that New Zealand, the youngest of the British Dominions, has a soil-erosion problem of greater significance in its relation to the future well-being of the country than has any one of the older members of the Commonwealth". He estimates that more than two thirds of the occupied area suffers from man-induced erosion.

The author approaches his subject from the geographical rather than from the agricultural point of view. Erosion in New Zealand has a regional character, assuming distinct forms according to the climate, geology and related land use. Four erosion regions are distinguished in the North Island and four in the South Island. The most striking, and in the North Island one of the most prevalent, forms of erosion is the landslip which has devastated immense areas following the clearing of the bush. Landslip erosion is the consequence not only of human intervention, but also of the geological structure of the country. It seems to occur as a result of a slight disturbance in a delicately balanced equilibrium of physical and biological forces—most frequently on steep, deforested land that has gone down to grass. A secondary result of erosion that has caused widespread damage in New Zealand has been the silting-up of rivers and consequent floods. A somewhat unusual form of erosion that is prevalent in certain areas is called by the author "subcutaneous erosion", and results in the washing away of the impermeable subsoil while the permeable, grassed topsoil remains intact. Ultimately gullies and sinkholes are formed. The rapidity with which erosion has occurred in New Zealand is due in no small measure to the extensive and repeated use of fire as a means of clearing the virgin bush.

Since New Zealand possesses few other major natural resources besides the fertility of the soil the problem of control is urgent. The author is more concerned with erosion than soil conservation, though the latter is discussed on general lines, and regional schemes based on adapting land use to the limitations imposed by the natural environment are suggested. Although the separate measures recommended—afforestation, improvement and control of pasture land, contour cultivation and strip-cropping—are those which are commonly advocated elsewhere, they require a different and unique synthesis into an integrated land-use programme, for the New Zealand climate is, on the whole, more maritime and less subject to extremes of temperature and humidity than the climates of most countries where erosion control has been scientifically studied. The author stresses the need for intensive research and State action on a large scale. In 1941 the Soil Conservation and Rivers Control Act became law, and a Soil Conservation and Rivers Control Council was set up with wide powers to carry out both conservation measures and research.

Sufficiently detailed accounts are given in a series of appendixes of the geological, climatic, vegetational and soil characteristics of the country to enable the reader who is unacquainted with New Zealand to get a clear picture of the geographical background of the problem. The book is illustrated with numerous beautiful and dramatic photographs. It should be read by everyone who is interested in this grave and widespread disease of the land. G. V. JACKS.

THE ELEMENTS RAGE

The Elements Rage

By Frank W. Lane. Pp. xii+188+47 plates. (London: *Country Life*, Ltd., 1945.) 10*s*. 6*d*. net.

THE more violent manifestations of Nature are of relatively infrequent occurrence, and so come into one individual's experience only at long intervals. If, then, we had to rely on the experience of one man only we should have a very inadequate picture of these abnormal phenomena. The author of the book under review has read and summarized a very great mass of literature dealing with hurricanes, tornadoes, waterspouts, hail, snow, lightning, meteorites, earthquakes and volcanoes, and from this has produced a readable book, in which a chapter is devoted to each of the nine topics enumerated above. To describe the book as readable is not to say that the reader will wish to devour it in one sitting. The rather overwhelming phenomena described can only be regarded as suitable for absorption in fairly small doses.

With the view of keeping the book free from error, so far as possible, the author had each chapter read over by at least one expert in the subject dealt with. The result has been to produce what is, on the whole, a reasonably accurate description of the phenomena, with an acceptable theoretical discussion in such parts of the book as call for theory. Here and there we find slips, which appear to indicate errors on the part of the experts, or failure of the author to listen to his experts. Thus on p. 2 we find the statement that "meteorologists define wind speed as the velocity with which the wind would carry a very light object, such as a fragment of thistledown, in a perfectly open situation, thirty-three feet above the ground". This is inaccurate, since wind speed can be defined at any height above the ground, and the wind at 33 ft. (10 metres) is a convenient specification of the surface wind.

But apart from a few unimportant slips, the treatment of the subject is clear and simple, and the book is well illustrated with photographs of tornadoes, waterspouts, hailstones, meteorite craters, earthquakes, volcanic eruptions, and of some of the dreadful damage produced by these phenomena. Among the most interesting parts of the book must be reckoned the four pages that describe the new volcano Paricutin in Mexico, which appeared in February 1943, the first new volcano to appear on the American continent in nearly two centuries. Paricutin appears to outdo Vesuvius in violence, being distinguished by its habit of spouting a hail of large fragments of lava thousands of feet into the air, and so endangering all forms of life in its immediate neighbourhood. A photograph of Paricutin in eruption appears as the frontispiece to the book, showing the magnificent plumes of smoke which tower high above the summit.

Mr. Lane has performed a very useful service to all who are interested in the violent manifestations of Nature, by writing a coherent account of these, and collecting into one volume the known facts relating to them. The book deserves to be widely read. D. BRUNT.

DUBLIN COLLOQUIUM, 1945

By Prof. MAX BORN, F.R.S.
Department of Mathematical Physics, University of Edinburgh

THIS year's Colloquium or Summer School of the Dublin Institute for Advanced Studies was held during July 5–18. I have described the character of the Institute and of these annual meetings in a review of Schroedinger's lectures on "Statistical Thermodynamics"[1]. The lecturers of this course were Dirac (Cambridge), Jánossy (Manchester) and myself, to whom was added less officially W. H. Peng, my former Chinese collaborator, who has now been appointed assistant professor at the Dublin Institute.

The audience was more international than during the war-time colloquia; apart from Peng, there were students from Brazil, Ceylon and Palestine, an Austrian sent by a London body (British Electrical and Allied Industries Research Association) and others. Yet the majority was Irish, some of them priests of the Roman Church. Coming straight from the Academy celebrations in Moscow, I was struck by the profound contrast between these two scientific meetings: there the materialistic idea that science has to serve social progress by producing practical results, here a spiritual attitude of pure research without regard to applications. The character of the conferences corresponded to these fundamental attitudes: in the U.S.S.R., stimulating addresses on wide topics by scholars of all nations, to vast audiences, and visits to enormous laboratories; in Eire, a small number of experts assembled for intensive study and discussion of a few abstract problems.

Yet, great as the difference of atmosphere may have been, one thing there was in common: the acknowledgment of the importance of fundamental research and of the perfect freedom of thought in its pursuit.

In fact, the experience in the U.S.S.R. and in Eire have strengthened my conviction that these two aspects, which are the driving forces behind scientific activity in Governments as well as individuals, are not contradictory but complementary, in a similar sense as the wave and corpuscle aspect are in quantum physics. Practically, both attitudes lead to a result pleasant to the man of science, namely, a highly honoured position in the community. The reception which we members of the Dublin Colloquium were given by the Government, the National University and Trinity College was no less friendly and in its smaller frame no less splendid than that I had experienced in the U.S.S.R.

The lectures and discussions covered three subjects: cosmic rays, quantized field theories and quantum mechanics of crystals.

Jánossy's six lectures dealt with our present knowledge of cosmic radiation, which consists at least of three different components: (1) a soft component (electrons and photons); (2) a hard component (mesons); (3) a component which is primary with respect to the (short-living) mesons, consisting probably of neutrons and protons. Jánossy's report was mainly concerned with the third component, which is much less thoroughly studied than the other two; only one of his lectures was devoted to a feature of the soft component—the cascade theory of showers of photons and electrons. His account of this very complicated mathematical theory was an astonishing feat considering it came from a man we used to look upon as an experimentalist. Concerning the third component Jánossy reported first on observations made by Rossi and Regener[2] of a non-ionizing component at high altitudes, and then on his own work, in collaboration with Rochester[3], near sea-level. This non-ionizing radiation is extremely weak and can be observed only with the help of particular tricks. The apparatus, consisting in a vertical coincidence arrangement of counters, has to be shielded against undesirable ionizing particles. Since absorbers would obviously not do, the shielding was performed with the help of a box full of counters (76 in number) in 'anti-coincidence' arrangement. Only those discharges of the inner counters are registered as 'anti-coincidences' which are not accompanied by a discharge of any of the screening counters in the box. An ionizing particle coming from outside the box must necessarily discharge at least one of the screening counters before reaching the inner arrangement; it produces, therefore, no 'anti-coincidence'. But a non-ionizing particle entering the box from outside does not affect the screening counters; by a proper arrangement of scatterers inside the box it has the opportunity of producing an ionizing secondary which is then registered. In this way the existence of non-ionizing rays more penetrating than photons could be established.

Showers of penetrating particles have been observed by Wathaghin and his co-workers[4] and independently by Jánossy[5] with the help of various counter arrangements. The rate of these penetrating showers was found to increase when absorbers of lead were placed above the counters; this indicates the production of secondary penetrating showers in the lead. The particles responsible for these showers were shown to be partly ionizing and partly not; their mean range was found to be about 5 cm. of lead. All these experimental results can be interpreted in terms of the theory, developed by Hamilton, Heitler and Peng[6], of the production of mesons by nucleons.

Another set of observations is concerned with the spreading-out over large areas of penetrating showers consisting of many particles[7]. The total energy of such showers is extremely high, and no interpretation of this phenomenon has been given so far.

Dirac's main subject was quantum electrodynamics (four lectures). But one additional lecture was devoted to quaternions, as a particular homage to their discoverer, Dublin's greatest mathematician, Sir William Hamilton. In this lecture, Dirac dealt with the application of quaternions to Lorentz transformations.

Previous work on this subject has always connected the Lorentz transformation with bi-quaternions, but here the need for introducing bi-quaternions was avoided by subjecting ordinary quaternions to a group of linear transformations with a denominator, which group is then reduced to just the Lorentz group. The method leads to an elegant formulation of the law of addition of velocities in relativity theory in terms of quaternions.

Dirac's method of treating quantum electrodynamics is to keep closely to classical electrodynamics. The Lorentz equations of motion of charged particles (including radiation damping) together with Maxwell's field equations may be considered as an exact classical scheme, which can be put into Hamiltonian form by using the 'Wentzel field'. From this Hamiltonian form of classical electrodynamics one can pass over

to the quantum theory by the same rules as for particle mechanics. The difficulty that then arises is to solve the resulting wave equations, as the ordinary perturbation method leads to divergent integrals.

One can make some progress by the device of introducing redundant field variables. This makes the solution of the wave equations much easier and avoids the divergent integrals, but throws the difficulty on to the question of interpretation. If one keeps to the standard method of interpreting wave functions in quantum theory, one must eliminate the redundant variables, and this would again introduce the divergent integrals if one expresses the wave-function as a power series in the electronic charge. However, from the general form of the wave function in the redundant variables it seems likely that one can carry out the elimination by better mathematical methods not involving power series, without getting divergent integrals. If this is so, it would mean that the appearance of divergent integrals in the solution of the wave equations is to be attributed to wrong mathematical methods and not to any fault in the physical theory.

A further lecture dealt with the way the wave functions of quantum electrodynamics transform under Lorentz transformations. These wave functions are not expressible in terms of tensors and spinors in space-time, but involve a new kind of quantity with an infinite number of components, which has already been dealt with[8].

Finally, a lecture dealt with what one can say about the *position* of a photon. A particle in non-relativistic quantum theory can have its position approximately defined, and its state is then described by a wave packet. This is no longer possible in relativistic theory; but it turns out that there is something playing the part of a wave packet, describable mathematically in terms of a complex variable of position.

My own lectures consisted of two quite different sets. In the first set (two lectures) I dealt also with quantum electrodynamics, or more generally with quantized field theories. The infinities appearing in these theories may be either a consequence of wrong physical assumptions or of bad mathematics. In the first case one must try to find a weak point in the present theory; this seems to me the use of the ordinary Fourier transformation connecting space co-ordinates with momentum components. Peng and I have shown that one can replace the Fourier method by a new set of commutation laws for the field components; the elementary oscillators represented in the older theory by quantized Fourier coefficients appear now as irreducible parts of the set of matrices representing the field components. To these parts we have given the name of 'apeirons'. The distribution of the apeirons can be chosen in such a way that the infinite integrals of the older theory become convergent. I further stressed the point that a satisfactory theory of interaction between different kinds of particles can only be achieved by treating all of them on the same footing, as quanta attached to the corresponding fields.

From this point of view Peng has made a careful investigation of the mathematical methods used in deducing the properties of particles, or quantized fields, in interaction; he gave a short account of this work in two lectures.

The ordinary method consists in an expansion with respect to powers of the coupling parameter (electric charge in the case of photon-electron interaction); this method fails because the unperturbed system is highly degenerate. Just as in ordinary quantum mechanics one has to apply the method of secular perturbations, Peng has shown how this can be done for a quasi-continuous spectrum. His results confirm in first approximation the theory of radiation-damping given by Heitler[9] and Wilson[10]. It seems certain that Peng's method allows us to calculate higher approximations for radiation and collision cross-sections without divergent integrals. About the question of self-energy, however, there was a controversy; Peng believed he had obtained a finite value of the so-called 'transversal self-energy', but Dirac raised objections to the proof. (Peng has since informed me that he has confirmed his statement.) The ordinary 'longitudinal' self-energy is not covered by Peng's present results; this infinity appears also in the classical theory and I doubt if it can be avoided in quantum mechanics except by Dirac's λ-limiting process.

My last three lectures were devoted to a much simpler subject, some problems of the theory of crystals. Raman and his collaborators have attacked ordinary lattice dynamics on account of optical experiments and tried to replace it by another theory. The main difference is this: they contend that a crystal lattice has only a finite number of vibrations, I think $48n$, where n is the number of particles in the cell, while the straightforward application of dynamics (classical or quantum theory) leads, of course, to the result that the number of vibrations is $3Nn$, where N is an extremely large number, namely, that of the cells. It would not be worth while to refute Raman's theory if all known facts could be explained by lattice dynamics; but that seems to be not the case. The reason is that the theory was developed before the discovery of quantum mechanics; the semi-classical model of a lattice used in my book[11] is insufficient. It is not the dynamical part, the theory of vibrations, that is deficient, but the optical part. The deformability of the ions had not properly been taken into account; but this can be easily done by describing their structure with the help of wave functions. I have revised the whole theory of crystals from this point of view and obtained a great number of new results. An example is the theory of pyro-electricity. There was an old discrepancy between experiment (Ackermann[12]) and theory (Boguslawski[13], Born[14]) with respect to the temperature dependence near the absolute zero; it was experimentally found to be proportional to T^2 while the theory gave T^4. This is now cleared up; the improved theory leads also to T^2. A second example is the fine structure of the residual rays (Reststrahlen) found by Barnes[15] and others. Blackman and I[16] have tried to explain it by taking into account the anharmonicity of the lattice vibrations. But I now consider this idea to be wrong; the phenomenon is a direct consequence of the deformability of the ions. Closely connected with this is the Raman effect of the second order. The first successful experiments were made by Fermi and Rasetti[17] on rocksalt; they interpreted their results in the correct way as a continuous spectrum with a number of small narrow maxima. Krishnan[18], however, claims these maxima to be a line spectrum as predicted by Raman's theory. Dr. Mary Bradburn and I[19] have developed the theory in detail and shown that the continuous background and the maxima as well can be derived in fair agreement with the experiments. I do not

doubt that the improved lattice theory will be able to explain all cases of Raman effect and other phenomena observed by the Indian physicists.

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THE ROYAL SCHOOL OF MINES

GEOLOGY, MINING AND METALLURGY AT THE IMPERIAL COLLEGE

By Prof. W. R. JONES

TOWARDS the middle of the last century, at the dawn of the industrial age, when the demand for machinery to quicken the pace of life was becoming more and more insistent, the value of the application of scientific knowledge to the many problems confronting Great Britain and the British Empire was becoming realized slowly but surely. In no sphere of activity was the need for such knowledge more marked than in increasing the supply of metals. The pressing demand for these necessitated the search by geologists for the minerals containing the metals; the working of the mineral deposits required mining engineers; and the extraction of the useful metals needed metallurgists. If rapid progress were to be made, it became manifest that the training of geologists, mining engineers and metallurgists was a matter of profound importance. It was the insistent demand for such training—not then available anywhere in the British Empire—that gave birth to what later became known as the Royal School of Mines.

At this period the Geological Survey had as its head Sir Henry de la Beche, a man of outstanding personality and vision who not only dominated the Survey but also wielded great influence with the Government. He had accumulated a large collection of minerals, geological maps, plans of mines and drawings of mining machinery which he housed at Craig's Court, adjoining Scotland Yard, London. This was opened to the public in 1841 as a Museum of Economic Geology to "exhibit the practical application of geology to the useful purposes of life". The exhibit aroused such great interest that the need for more accommodation caused the Government to erect a new building, and on May 12, 1851, the Museum of Practical Geology in Jermyn Street was opened by the Prince Consort.

This gave de la Beche the opportunity he had long cherished of using the Museum and its collection for training in mining and applied science; and six months later, on November 6, he delivered the inaugural address as director of the Government School of Mines and Science applied to the Arts. In preparation for this new School, he had gathered around him a group of the most eminent men in their particular subjects: Warington W. Smyth for mining and mineralogy; Andrew C. Ramsay for geology and its practical application; John Percy, the 'father of English metallurgy'; Robert Hunt for mechanical science with its application to mining; Edward Forbes for natural history applied to geology and the arts; and Lyon Playfair—afterwards Lord Playfair—for chemistry applied to the arts and agriculture. It is an outstanding tribute to the genius of de la Beche in the selection of his staff that every member of this brilliant group became a fellow of the Royal Society and achieved international fame; and together they established for the School an unsurpassed reputation throughout the Empire.

After the death of Sir Henry de la Beche in 1855, Sir Roderick Impey Murchison, a virile leader, succeeded after many rebuffs in changing the title of the School in 1857 to the Government School of Mines, and in 1863 to the Royal School of Mines, the title which it still retains as one of the components of the Imperial College of Science and Technology. The School was transferred in 1872 from Jermyn Street to the Royal College of Science (now the Huxley Building) in South Kensington, and, in 1913, to its nearby present home in Prince Consort Road.

The Royal School of Mines is essentially a teaching institution, fulfilling the purpose for which the Imperial College of Science and Technology was incorporated: "to give the highest specialised instruction, and to provide the fullest equipment for the most advanced training and research in various branches of science, especially in its application to industry". Its particular function is training in the application of the principles of science and engineering to the fundamental industries of mining, metallurgy, and oil.

Geology

From the initial stages of the School, the Geology Department has been closely linked with the Mining and Metallurgy Departments, and with the passage of time this link has become more strongly forged, for now the three departments are housed together in the Royal School of Mines. Two thirds of the students of the Department receive the associateship of the School; the remaining third, studying pure geology, belong to the Royal College of Science. During the last twenty years almost all the students attending the School in any of its departments sit also for the Honours B.Sc. of the University of London.

Sir Henry de la Beche, the founder of the School, Sir Roderick Murchison, his successor as its director and head of the Geological Survey, and Sir Andrew Ramsay, its first professor of geology (1856–76), were all eminent geologists, who played a great part in laying the sure foundations of their science and in building upon them its broad developments. Their achievements have become incorporated in the body of the science.

Advances in geology are rarely spectacular; it is more a case of "precept upon precept, line upon line, here a little, and there a little". The Geology Department can look back with satisfaction on a century of productive research in all branches of the subject.

Judd (1878–1905), who succeeded Ramsay, made sound contributions to the Jurassic and Cretaceous stratigraphy of Great Britain, and the results of his investigations into the complexities of the Tertiary vulcanicity of the Hebrides are of signal merit. It has been truly stated of him that he established the "first thorough course of practical instruction in geology established in Britain, and perhaps in the world". He trained a group of practical geologists who have made their mark on geological science in all parts of the world—a group containing Boulton, Grenville Cole, Hume, Sir Thomas Holland, Skeats, Cullis, Tyrrell, Morley Davies, Rutley, Sherlock and many others is no mean memorial.

Judd was followed by W. W. Watts, who occupied the chair during 1905–30. His contributions to the stratigraphy and petrology of Shropshire and the Midlands remain of fundamental importance to the geology of Britain. Invaluable also have been his services to the science as its counsellor. Building upon the foundations of his predecessors, he expanded the departmental courses to keep abreast of progress, and in his teaching he inspired his students and colleagues to undertake research work in various branches of geology. Under his guidance, two new sub-departments were instituted to supply men trained for special work in the oil and mining industries. That in oil technology, comprising geology, surveying and engineering was established in 1912; and under the direction of Prof. V. C. Illing it has prospered exceedingly and has supplied fully trained men to oil companies in various parts of the world. The second special training is in mining geology, which includes in addition to geology, surveying, assaying and the principles and economics of mining. This training was fostered by Prof. C. G. Cullis with such success that the demand for graduates in mining geology has always been greater than the supply. Cullis was followed in the chair by W. R. Jones, its present occupant.

Under Watts there thus began the production of highly trained practical geologists, many of whom now hold chairs in British universities, are members of the Geological Survey, directors of Colonial Geological Surveys or consultants to mining and oil companies. A roll of the distinguished old students and colleagues of Watts would include Boswell, Bracewell, Brammall, Bulman, Dewhurst, Eastwood, Broughton Edge, Fitch, Hitchin, Holmes, Ingham, Jones, Lepper, Read, Edmondson Spencer, Stubblefield, Wade, Wayland, Whitehead, Whittard and many more.

In this way, the Geology Department of the Royal School of Mines, like those of Mining and Metallurgy, has made a very great contribution to Colonial and Imperial development, and can justly consider itself a worthy part of an Imperial College. While a most important function of the Department is this training of high-class geological technicians for the oil and mining industries, just as important a function is the provision of postgraduate training, especially for Dominion, Colonial, Indian and foreign graduates. On many occasions, the student population of the postgraduate school of the Geology Department has been made up of men from a dozen countries.

Watts was succeeded by Prof. P. G. H. Boswell, who continued the development of the postgraduate school and himself established much of the basis of modern sedimentary petrology following his important work on British glass- and moulding-sands. In 1939, Boswell retired for health reasons and was followed by the present head of the Geology Department, Prof. H. H. Read. The codification of views upon granitization and its relation to metamorphism have been the subject of three presidential addresses by Read, and his far-reaching proposals for a genetic classification of rocks are widely acknowledged to merit careful consideration.

Among researches carried out in the Department during the last decade may be mentioned those of Illing on oil geology, Hobson on the compaction of sediments and the properties of clay suspensions, Wood on the algæ, Jones, Brammall and Leech on the etiology of industrial dust diseases, Brammall and Leech on metamorphic granitization as developed in Dartmoor and the Malverns, and many more.

The chief contributions to the advance of geology during the last century from the Geology Department have thus been the establishment of the basic principles, a large output of competent original work, a great production of trained men especially in oil and mining geology fitted for service abroad, and the formation of a strong and varied postgraduate school which attracts students from all parts of the British Empire and from foreign countries.

Mining

The progress during the century in underground activities is no less important, though less known, than that of surface transport from the days of the stage-coach to the most modern motor-car. Especially is this so in the type of mining with which the Royal School of Mines is concerned. Hand-drilling has been replaced by pneumatic-drilling, gunpowder by gelignite and other highly efficient and safer explosives, hand-loading by mechanical scrapers; transport from the working-face of the broken ground is no longer by man-power but by mechanical traction, horse-whins for raising the material to the surface have given place to power winding-machinery, pits of a maximum depth of a few hundred feet have become shafts thousands of feet in depth, and ventilation arrangements of the crudest kind have been replaced by well-planned systems employing large fans of high efficiency, aided, in the deepest and hottest mines—some of which are more than a mile and a half below the surface—by refrigerating plants. These are some, but not all, of the great improvements in the art of mining during the last few decades.

Concerning all these advances, the Mining Department of the School has been and still is the premier place in the British Empire for the training of the mining engineers who, in co-operation with other engineers in their different spheres, have made such progress possible.

The Department was particularly fortunate in its first professor, Sir Warington Smyth. On leaving Cambridge, Smyth spent four years on the mining fields of Europe and the Near East, advising mining companies and collecting representative samples of minerals and rocks from those fields. On his return, he joined the staff of the Geological Survey, became chief mineral inspector of the Office of Works and of the Duchy of Cornwall and adviser to the Crown on all mining matters. His knowledge of geology, and of its practical application to mining, formed the basis on which he built the mining course at the School. Since his day the subjects forming the course have increased considerably in scope with the progress of science; but during the hundred years that have elapsed, the principles of geology have remained

a fundamental part of the training of the mining engineer.

Smyth was followed in the chair by Clement le Neve Foster, Herbert Cox, William Frecheville and S. J. Truscott, all men of great eminence in the mining industry before they accepted the professorship. They were able to present to their students first-hand information concerning the mining problems of their day and the improvements they visualized in the future, thus to inspire their hearers to keep abreast of their subject and to retain the international reputation of their forerunners. The standard of athletic prowess set by the first head of the Mining Department—a Rowing Blue—has been maintained by the present head, Prof. J. A. S. Ritson, a former English International Rugby player.

Progress in mining is achieved in the mines, not in college laboratories. Some practical improvement in the art of mining is of almost daily occurrence; and although this is the fruit of research, it is not of the kind that results in the publishing of scientific papers. Thus it is that the strength of the Department lies in its training to bring about these useful practical improvements in the mines rather than in research work carried out within its doors.

In fulfilling this, its most important function, it has been very successful. The excellence of its training has attracted students from all parts of the British Empire. The Department is unique in the number of awards granted to its past students by professional mining institutions, and in the positions of highest responsibility in the mining world occupied by its *alumni*. The A.R.S.M., the diploma awarded to its students, has an unsurpassed reputation in the Dominions and the Colonies, where almost all its students go on leaving the School; and the demand by the Colonial Governments and mining companies for those trained in the Department has always been greater than the supply. Particularly is this so during the past few years, when only a small fraction of the posts offered could be fulfilled.

Metallurgy

The first English text-book on metallurgy was written by Dr. John Percy, the first professor of metallurgy at the Government School of Mines and of Science applied to the Arts, later to be known as the Royal School of Mines. Percy has been truly described as the 'father of English metallurgy', and it could well be stated that for the first decade of his professorship, his department was the cradle in which British metallurgy was nurtured. Among the results of his many successful researches was the adoption for the Patera process in 1858 using sodium thiosulphate for the leaching of silver ores.

In those early days, phosphoric iron deposits remained useless as a source of iron, for no method was known by which the deleterious phosphorus could be removed. Percy Carlyle Gilchrist, in association with his cousin Sidney Gilchrist Thomas, and inspired by John Percy, carried out experiments which ultimately established the basic Bessemer process for converting phosphoric pig iron into good-grade steel. The first patent was taken out in 1877 and from it was developed the modern basic steel industry.

Percy was professor during 1851–80, and was followed by Sir William Chandler Roberts-Austen (1880–1902), an exceptionally able and inspiring teacher, who fostered the growth of physical metallurgy—then in its babyhood—to such a degree that his team of researchers, which included D. G. Bengough, O. F. Hudson, W. H. Merrett and A. Stansfield, made notable advances in the study of metallography.

William Gowland, then a well-known authority on the metallurgy of copper, followed Roberts-Austen and was professor during 1902–9. He completed the Fifth Alloys Research report, the first four having been published by his predecessor.

For the five following years, 1909–13, the chair was occupied by William A. Carlyle, who had been manager of Rio Tinto Mines and smelter. His wide experience in industry enabled him to impress on his students the importance of understanding practical operations on a large scale.

Sir Henry Cort Harold Carpenter was professor from 1913 until his tragic death in 1940. Under his direction, considerable advances were made in the study of corrosion of metals and, in collaboration with Miss Elam (Mrs. Tipper), the first single crystals of aluminium were produced, thereby providing data which have proved of fundamental importance. As chairman of a large number of Government commissions and research institutions, he was able to exercise great influence in promoting the advancement of knowledge in a wide variety of metallurgical operations.

In the course of the century, the Department has produced many metallurgists of outstanding eminence, and professors who, in their turn, have grafted on their universities the courses initiated at their *Alma Mater*. Among its brilliant students were C. O. Bannister, C. V. Boys, A. J. Brett, A. C. Claudet, Sir Lewis Fermor, P. C. Gilchrist, F. W. Harbord, O. F. Hudson, W. F. Hume, Henry Louis, A. McCance, B. McNeill, T. A. Rickard, E. Riley, Sir Thomas Rose, S. W. Smith, A. Stansfield, T. Turner, and E. A. Wraight.

The Royal School of Mines, proud of its achievements, is beginning its second century in a spirit of high endeavour, fully confident that it will continue to produce the highly trained geologists, mining engineers and metallurgists who during peace and war have served Britain and the British Empire with conspicuous success.

THE ALLIED PLAN FOR EDUCATION

By Dr. E. F. ARMSTRONG, F.R.S.

THE United Nations Educational, Scientific and Cultural Organisation (U.N.E.S.C.O.) commenced its deliberations in London on November 1 and was able to have its constitution agreed and signed by the representatives of forty-four nations on November 16. The principal object of this Conference was to draw up the constitution of the new body; the delegates attended primarily, therefore, in a diplomatic rather than an educational capacity.

Perhaps the outstanding achievement to many of us is the inclusion of the word 'Scientific' in the title as well as in all pertinent places in the text. Science has now world recognition as an equal partner in the great task of world educational reconstruction.

It is generally recognized that the failure to set up an educational body on the same lines as the International Labour Office after the First World War was a serious omission. The remarks of the

Prime Minister, Mr. Attlee, at the first session of the Conference, form the first sentence of the preamble to the constitution "that since wars begin in the minds of men, it is in the minds of men that the defences of peace must be constructed". It is by education alone that men of all classes in all countries can get to know and understand one another. Hence the general view among delegates that they were forging the best possible instrument of peace—a peace based on the intellectual and moral solidarity of mankind.

The first and most immediate object of U.N.E.S.C.O., when it begins its real work, must be to bring help to education in the backward countries. A backward citizen is not necessarily a bad citizen, but his country will be stronger in the measure that he ceases to be illiterate.

People are thinking to-day as perhaps never before. There is universal agreement on a higher standard of life for all, though silence about the fact that it requires education both to attain it and enjoy it. Some advocate a classless society without realizing the impossibility of there being any such thing. The Fascist State, whether of the extreme right or the extreme left, advocates the vice of mass thinking; scientific workers lead in demanding freedom of every kind. Pessimists proclaim that nothing will ever be the same again, while the optimists hope to change human nature by 'order in council'. The truth is that we are unable to decide between what is permanent and what is ephemeral, or as Charles Morgan has so admirably said, "the middle truth appears to be that in all societies and at all times there are both constants and variables, and that what gives to an age its distinguishing character is the relationship, the friction between them".

But this article is primarily to deal with the effect of the new organization on science, national and international. It can be profound, but the future must be shaped by our own efforts; it cannot and must not be left to others while we sit back and criticize.

The U.N.E.S.C.O. originated, as is well known, in part from the Conference of Allied Ministers which began work in London on the initiative of Mr. R. A. Butler, then Minister of Education, in October 1942. In July 1943 it set up a Science Commission. The primary work of the Allied Ministers Conference was to make preparations so as to be ready to aid the essential work of educational and moral reconstruction when their countries were freed; hence the original task given to the Science Commission was to work out the requirements for scientific and laboratory equipment. A general picture of the problem as a whole was obtained and, for the first time, an idea of the magnitude of the scientific equipment of the countries concerned was gained. As a result of their work seventy-six detailed inventories—of many thousands of items—have been compiled. These form a unique catalogue of the necessary equipment of laboratories for a wide range of sciences such as had never before existed. They will form valuable works of reference for many years to come and greatly facilitate both the task of rehabilitation and the setting up of a laboratory in any part of the world.

Apart from this specific achievement, the Science Commission has taken all possible steps in a variety of directions to be able to guide and assist the restoration of science at all levels in the occupied countries, and it can form a basis for the science division of the Preparatory Commission of U.N.E.S.C.O.

Perhaps it is appropriate here to chronicle that the Conference set up a Preparatory Commission to take all necessary steps to bring the new body into physical being and start its work, in particular to get ready the agenda for the first real meeting, which can only take place after a sufficient number of nations have ratified their acceptance of the constitution. When this happens the home of U.N.E.S.C.O. will be Paris. In the meantime Sir Alfred Zimmern is acting as secretary and the business is being conducted from London.

Two different themes were in the minds of all the delegates: one, the legalistic drafting of the constitution; the other, humanitarian, the need to help in rehabilitation of the devastated countries. It required skilled conduct on the part of the chairman of the various meetings to keep the two subjects separate in the discussions. Finally, the rehabilitation aspect was referred to a Technical Committee to be set up by the Preparatory Commission and to come into being at once.

The last session of the Conference was devoted to restoration and closed on a high note of urgent need; the meetings which followed immediately concerned themselves with procedure and oratory and involuntarily brought to mind those words of Macaulay:

"Those behind cried forward,
Those before cried back."

Admittedly, it is difficult to see how best to ensure the provision of aid since this is dependent inevitably upon action by individual nations or existing international relief organizations.

The Conference had before it as the working document a White Paper prepared by the Allied Ministers Conference which substantially was adopted. In this White Paper the word 'Science' was lacking, but its insertion was urged by the United Kingdom delegation largely on the insistence of Miss Ellen Wilkinson, who so efficiently acted as president of the Conference. The proposal met with no serious opposition. Arguments as to whether science is included in 'Culture' are interminable and serve no useful purpose. The nations of the world were concerned, not Britain alone, and to them the inclusion of the specific word 'Science' had a real meaning.

Delegates from the South American countries, from Turkey, China, Egypt and many other, including the Arab countries, all gave the assurance that new status had been given to teachers of science so that their powers would be increased and their prestige enhanced. The same consequence can be made to apply even in Great Britain, where science is still largely an extra, though honourably bracketed with music and dancing!

Charles Morgan writes of "a confluence of ideas flowing from the nations into the stream of civilization". The opportunity now exists to make science supply some of the tributaries of this stream.

Nature, in its issue of November 15, gave full space to the views expressed by some of our leaders regarding the proper future organization of international science, so that there is no point in expressing further views of a detailed character.

The constitution of U.N.E.S.C.O. is permissive, as every well-drafted instrument should be. 'May', for example, in Article 8, enables it to co-operate with outside international bodies presumably of repute, whereas 'shall' is mandatory and forces recognition of any body with headed stationery and a brass plate on the door.

The primary and indeed essential need is for science to be represented from the very beginning on the Secretariat of U.N.E.S.C.O. The secondary action may well be for us, first nationally and then internationally, to make the existing or new scientific organizations of various types both representative and efficient so that they can claim recognition from U.N.E.S.C.O. at an early stage. The proposals put forward by the Association of Scientific Workers, as representing the work which the scientific division of U.N.E.S.C.O. should do, are admirable but they would take several years to bring to fruition, and demand a large and highly qualified administrative staff at a moment when there is a great dearth of scientific workers for productive work. Moreover, the question arises whether all these matters should be handed over to bureaucrats, for that is what they will become, even though they started as men of science. The docile are not always the virtuous. Is it not wiser to maintain the freedom which we cherish, which some think we are in danger of losing, and organize these things for ourselves while becoming closely affiliated to the world organization ?

There is so much to do to-day that we are accustomed to priorities in every sphere of activity. U.N.E.S.C.O. must have priorities, some undoubtedly far higher than the claims of advanced science : this is the main reason why we must do some things for ourselves if they are to be done soon.

Happenings the world over rightly interpreted may be taken as evidence of strength in our civilization. The responsibility for the recreation of the moral life of the world will fall heavily on us; in this we dare not fail. As R. A. Butler wrote the other day, the Conference "must ensure that the world of Education, like that of Science, does not become the plaything of purely Governmental machinery, either in any one country or in any international organisation".

In the next few months U.N.E.S.C.O. will have to establish its organization. It has a precedent in the International Labour Office. The Executive Board is representative of eighteen governments and elected by the Conference ; there is to be a director-general and a permanent secretariat. Perhaps it should at once break down its work into sections, of which science will undoubtedly be one. Men of science should proceed without delay to set out in clear and, above all, practical terms, avoiding too great a length, the work and problems which this Science Section should envisage as its first tasks. It must be remembered that the non-scientific workers have still to be educated regarding the nature and the value of the help which the scientific attitude of mind can give them ; at present they are sceptical, even suspicious of the motives of men of science and confused by the scientific habit of speaking with so many contrary voices on any subject.

The Conference was well attended, several countries sending large and influential delegations. As always on these occasions, perhaps most was effected by private conversations or smaller meetings, among which were several for the scientific delegates.

Many delegates were closely connected as teachers with education in their own countries, including some of the more backward in the educational sense. They were outspoken in the benefits which U.N.E.S.C.O. could give them : money spent on education instead of armies, a life in which cultural interests, the drama, art, science and literature could play a part instead of power politics and the fear of future war; a life in which mutual understanding and knowledge instead of ignorance of each other's ways and lives could be developed; a life of travel and interchange of visits (extending over weeks and months) of children, students, teachers, professors, research workers, all men and women of sympathy and goodwill promoting peace and an international outlook instead of narrow nationalism and suspicion; a life in which technical progress was for the service of man and not for his destruction.

INSTITUTION OF METALLURGISTS

INAUGURAL MEETING

As a craft, the metallurgical art is of the greatest antiquity : in the speculative development of natural science, the metals have played an important part. During the Middle Ages, the Guilds and Livery Companies exercised a beneficial influence in demanding proofs of competence from the craftsmen working with metals; but as the importance of these bodies decreased, this control diminished, and since then, until the last few weeks, there was no organization, in Great Britain at least, which was responsible for certifying metallurgists as being professionally competent. University qualifications are clear proof of this ; but there are many who, for reasons outside their own control, have never had the opportunity of obtaining such training or 'hall-mark'.

In the Iron and Steel Institute and the Institute of Metals, Britain possesses two bodies which have done great service to the metallurgical industries, and to the community in general, as the avenues through which metallurgical research and developments have been made known ; but membership of neither is recognized as proof of more than interest in the ferrous or non-ferrous metals.

For some years, there has been a growing feeling that a strictly professional body, somewhat similar to those which exist for chemists and engineers, was needed, and the two Institutes have had the matter under consideration. It was ultimately decided that the demand would be best met by the establishment of a new organization, admitting only qualified workers in the field of metallurgy, and having functions supplementary to, and independent of, the two existing metallurgical institutes.

On September 15, 1945, the new Institution of Metallurgists was incorporated and licensed by the Board of Trade, and on November 28 the inaugural meeting was held, under the presidency of Dr. H. Moore, at 4 Grosvenor Gardens, London, S.W.1, the offices of all three bodies. Attended by metallurgists of repute in all branches of the art and science—the presence of Prof. T. Turner, the *doyen* of English academic metallurgists, gave, perhaps, the greatest pleasure—and with the support of representatives of very many similar scientific and professional societies, the support and collaboration of which will be most welcome, the Institution was launched under conditions of the most complete harmony.

After outlining the reasons for the formation of still another society, Dr. Moore expressed his and the Institution's satisfaction at the presence of so many distinguished guests, and pointed out that the Institution was still under the control of a 'caretaker government' until the first general election of officers to be held in the earlier part of next year. He then introduced the Hon. R. G. Lyttelton, treasurer

of the Iron and Steel Institute, who on behalf of one of the 'parents' wished the Institution every success. Dr. W. T. Griffiths, president of the Institute of Metals, followed and reminded the meeting of the work done by the late Dr. T. Swindon in the early days of the discussions which had that day come to fruition. Throughout, the assistance of the two parent organizations was most cordially acknowledged. The value of the work of Dr. Moore himself, and that of Mr. K. Headlam-Morley, the secretary of both Institutes and of the new Institution, was stressed by Dr. J. W. Jenkin, vice-president, without which the formation of the Institution would have been considerably delayed.

To these gentlemen and to the two Institutes, the Institution of Metallurgists owes a very deep debt.

NEWS and VIEWS

Science and Reconstruction

In addressing the Manchester Joint Research Council on "Science and Reconstruction" on December 6, Sir John Anderson referred to his own early career to emphasize that a good grounding in natural science can be a passport to the higher Civil Service and that public administration does provide scope, apart from the professional or specialist grades, for men with a scientific training. Sir John associated himself with the view that the restoration of the economic life of Britain, and even the maintenance of pre-war standards of living, depends on building up our industries to a level of efficiency higher than ever before attained; and in support of this view he referred to some outstanding British technical achievements during the War to establish his contention that, while we have lagged behind in the past and men of science have to get rid of prejudice against applied science, the prognosis for the application of science in industry during the period of reconstruction is extremely favourable. Considering what is still needed, Sir John dealt first with the question of personnel. The output of scientific workers is below that which the real needs of the country demand, and too little was made of the importance of scientific and technical education during the passage of the Education Bill last year; indeed, the needs of industry may at first have to give way to those of the universities. Urging the importance of preparing a quantitative and qualitative estimate of future requirements of trained men and women, Sir John welcomed the appointment by the Lord President of the Council of a committee to deal with the question of scientific man-power and also pressed for accelerating the release from the Forces of trained men of science and students.

Dealing next with the question of finance and the recent increased Government grant to the universities of Britain and to the new allowances in regard to tax relief for research expenditure, Sir John instanced a number of recent university endowments by industry as illustrating the value of such relief. He believes that so far as financial aid is concerned, we have a framework within which all that is required can be secured. The efficient use of the limited resources of Britain, however, demands the best possible organization, and here Sir John suggested as worthy of exploration a number of questions in regard to remuneration, mobility and interchange of staff and information or ideas, pensions schemes and the like on the lines of the recommendations in the recent Barlow Report on scientific staff. Research in applied science in teaching institutions should not be discouraged, though they should not be encouraged to undertake agency or contract work. The advantage of allowing some fundamental research in industrial research establishments should be recognized, and industrial associations might discuss with representatives of the universities and Government research organizations long-term programmes of research and what fundamental researches can most profitably be conducted in Government establishments or centrally in selected institutions.

Sir John Anderson unhesitatingly rejected the idea of a Minister of Science and suggested that the Lord President of the Council should be formally recognized as the Minister responsible for dealing, on behalf of the Cabinet, with all general scientific questions in which the Government is concerned, including problems of organization and arrangements for Commonwealth or international conferences. The Scientific Advisory Committee should be placed on a peace-time footing with some extension of staff, as the principal adviser of the Lord President and the Cabinet in scientific matters. Sir John would also create a special section of the Cabinet secretariat to assist the Lord President in the discharge of his new responsibilities. Finally, referring to the investigations into atomic energy, Sir John said that nothing had been discovered to justify the expectation that the energy released by an atomic explosion could be used directly as a source of industrial power. The only practicable method appeared to depend on the conversion into heat of the energy released by a controlled process of nuclear fission. The vast range of new radioactive substances, including radioactive forms of common elements used in medicine, which the new devices provide is probably much more important and beneficial and may bring a revolution in medical science.

Industrial Research in Great Britain

The Industrial Research Bill introduced into the House of Lords on November 29 by Lord Barnby was withdrawn after a speech by Lord Pakenham in which he indicated that although there was no active opposition to the principle of an enabling Bill, only about a dozen industries out of the eighty or ninety consulted by the Government on their post-war problems had indicated that they might take advantage of such legislation to finance any of the joint activities mentioned. Owing to the extreme pressure on parliamentary time during the present session, the Government would be unable to give facilities for the Bill; but whatever might be the position in the future, finance is not at present the main trouble. After referring to the announcement of the Lord President of the Council in his speech on November 6, Lord Pakenham emphasized that the Government appreciates that in some industries a statutory levy would give research associations the security of revenue necessary to allow them to plan useful long-term research and would have other advantages. Accordingly, the Government had the

matter still much in mind, along with the allied question of statutory levies to finance other desirable co-operative activities. The Government does not wish to discourage industries which have plans under consideration from proceeding to work them out in detail, even if those plans will ultimately need statutory power to give effect to them. Emphasizing the importance which the Government attaches to a rapid improvement in the scientific basis of our industrial production, Lord Pakenham said that the Government could do a little to help in that matter; but primarily such improvement must depend on the willingness of industrialists themselves to devote resources to research, and it must depend still more on their willingness to exploit the results of scientific research.

Dr. A. D. Imms, F.R.S.

Dr. A. D. Imms has retired from the readership in entomology at Cambridge, which he had held with distinction since 1931. Dr. Imms was the first holder of this readership, the establishment of which resulted from an endowment by the Rockefeller Foundation, made with the avowed intent of strengthening in Great Britain those sciences which are fundamental for agriculture. The appointment of Dr. Imms seemed almost inevitable. After taking his degree in London, Dr. Imms held an 1851 Research Scholarship at Corpus Christi College, Cambridge, during 1905–7, and then took up the appointment of professor of biology in the University of Allahabad; for two years, during 1911–13, he was forest zoologist to the Government of India, after which he became reader in agricultural entomology at Manchester, establishing there a tradition for entomological research which has lived on. But it was not until his transfer to Rothamsted in 1918 as chief entomologist that his full stature came to be appreciated. In 1924 Dr. Imms published his "Text-book of Entomology", and at once he became recognized as the leader of entomology in Great Britain. This excellent book has gone through three editions, and is almost as widely used in the United States as it is in Britain. "Recent Advances in Entomology" followed in 1931, and during the War Dr. Imms produced an admirable "Introduction to Entomology". The influence of these books has been immense, and will long continue. It is good to know that Dr. Imms intends to pursue his literary work in the milder climate of Devon, and we may hope that the entomological world at large may long enjoy what Cambridge has regretfully lost.

Dr. V. B. Wigglesworth, F.R.S.

Dr. V. B. Wigglesworth has been appointed to the readership in entomology in the Department of Zoology, Cambridge, vacated by Dr. A. D. Imms. In addition, he is in charge of a Unit of Insect Physiology of the Agricultural Research Council. After some postgraduate work in biochemistry at Cambridge, Wigglesworth held posts in the Department of Entomology at the London School of Hygiene and Tropical Medicine, during 1921–43. The Department was under P. A. Buxton, who was interested in precise field-work on the ecology of insects, and Wigglesworth made complementary studies on physiology, exploring many sides of the subject, including the behaviour of insects. His work went deeply into the pure science, the view being taken that a proper understanding of physiology is one of the foundations of applied entomology. He showed himself a master of the carefully planned experiment and of the simple technique. Not infrequently his experiments with insects have proved to be important contributions to general physiology. His book, "The Principles of Insect Physiology", first published in 1939, is an important contribution to biological science.

Dr. Kenneth Mellanby

Dr. Kenneth Mellanby has been appointed to the University readership in entomology tenable at the London School of Hygiene and Tropical Medicine in succession to Dr. Wigglesworth as from October 1. During 1930–36 Dr. Mellanby was engaged in research work at the London School of Hygiene and Tropical Medicine, and in 1936 he was elected Sorby research fellow of the Royal Society. He joined the R.A.M.C. in 1943, but was released in 1944 in order to proceed to South-East Asia for research on behalf of the Medical Research Council.

Earthquake in the Arabian Sea

The greatest shock ever recorded by the Riverview Observatory, Australia, was registered by seismographs throughout the world about 10.6 p.m. G.M.T. on November 27. The epicentre may have been near lat. 24° N., long. 64·5° E., about 180 miles from Karachi in the Arabian Sea. *The Times* correspondent at Delhi suggests it may have been near the double ridge which encloses an 8,000-ft. deep gully on the bed of the Arabian Sea. The ridge was first plotted by the John Murray Expedition of 1933–34 and is probably a continuation of the Kirthars Range between Sind and Baluchistan. Mr. E. W. Pollard, in the Isle of Wight, recorded the earthquake at 22h. 06m. 24s. G.M.T.

At Karachi the shock was accompanied by rumbling but no damage has been reported except for a few broken windows. The earthquake was felt throughout the Las Bela State of Baluchistan, and at Banjiguar in Baluchistan. A tremendous sea wave, presumably caused by the earthquake, occurred about the same time at several places on the coast. In the Bombay suburbs of Juhu and Versova boats were smashed at their moorings and some people standing on the shore were carried out to sea. The bodies of three women were recovered. It is reported in *The Times* that the bodies of seven of the nine persons caught by the wave at Mahalaxmi, opposite Bombay's racecourse, have been recovered. Most of the victims appear to have been caught on the causeway connecting an ancient Muslim mosque, which is built on a rocky outcrop, with the mainland. This causeway is usually under water at high tide. The wave was most severe on the coast of Makran, north-west of Karachi. At Pasni a number of people are reported to have been washed away and the post and telegraph office together with other buildings damaged. The Government of India has voted one lakh of rupees for the relief of victims. The damage and loss of life, though great, is thought at the moment to have been estimated too high, and official figures are awaited. The officer in command of the Royal Indian Navy warship *Hindustan*, the first relief ship to reach the coastal area in question, has signalled news of two new islands in the Arabian Sea about 180 miles west of Karachi. They are stated to have appeared after the recent earthquake and

[None of the vacancies in these columns relates to a Man between the ages of 18 and 50 inclusive or a Woman between the ages of 18 and 40 inclusive, unless he or she is excepted from the provisions of the Control of Engagement Order, 1945, or the vacancy is for employment excepted from the provisions of that Order.]

MANCHESTER ROYAL INFIRMARY

TECHNICAL ASSISTANT (HAEMATOLOGY) FOR CLINICAL LABORATORY WORK

(Non-resident, Male or Female)

The Board of Management of the Manchester Royal Infirmary invite applications for the above post.

Applicants should either hold a degree in science or have passed the appropriate final examination of the Institute of Medical Laboratory Technology or have had special training in scientific methods of a suitable nature. The work involves mainly routine examinations of blood, basal metabolism, etc. The duties of the post require attendance daily (Sundays excepted) from 9 a.m. to 5 p.m., Saturdays to 1 p.m. working under the direction of the Director of the Department of Clinical Pathology.

The appointment will be that of a Grade "B" Technician under the scheme issued by the Joint Committee on Salaries and Wages (Hospital Staffs), commencing salary £300 per annum rising by annual increments of £15 to £420 per annum. The selected applicant should be prepared to stay for at least two years if satisfactory. Federated Superannuation Scheme in force. Applications (stating age) with testimonials to be sent to the undersigned.

F. J. CABLE,
General Superintendent and Secretary.

BOROUGH OF SWINDON EDUCATION COMMITTEE

APPOINTMENT OF LABORATORY STEWARD —THE COLLEGE (TECHNICAL INSTITUTION AND SECONDARY SCHOOL)

Required immediately, full-time Laboratory Steward to supervise the maintenance of apparatus, equipment and stock in the College Laboratories and to assist in demonstrations. Candidates should be between the ages of 25 and 35 years, should have had a good general education and experience of practical laboratory work, with some skill in glass-blowing and the repairing of apparatus. Salary £180 per annum, rising by annual increments of £10 to a maximum of £220 per annum plus war bonus (at present £59 16s. per annum). The appointment will be subject to the provisions of the Local Government and Other Officers Superannuation Act and the selected candidate will be required to pass a medical examination.

Form of application, which will be forwarded on receipt of a stamped addressed envelope, should be returned to the undersigned at the Education Office, Civic Offices, Swindon, so as to be received not later than December 29, 1945.

H. DIBDEN,
Director of Education.

MIDDLESBROUGH EDUCATION COMMITTEE

CONSTANTINE TECHNICAL COLLEGE

Principal: H. V. Field, B.Sc., Wh.Sch., M.I.E.E.

Applications are invited for the post of full-time Lecturer in Chemistry (chiefly Organic) to Honours Degree standard. Candidates should possess a University Degree or its equivalent. Industrial experience would be an advantage.

Duties to commence as soon as possible after January 1, 1946.

Salary: Burnham Technical Scale.

Application forms and further particulars from the undersigned, to whom they should be returned not later than December 22, 1945.

STANLEY HIRST,
Director of Education.
Education Offices,
Middlesbrough.

UNIVERSITY OF BIRMINGHAM

FACULTY OF SCIENCE

Applications are invited for the post of LECTURER IN CHEMICAL ENGINEERING in the Department of Oil Engineering and Refining. Candidates should have an Honours Degree in Science, preferably Chemical Engineering. Chemical Engineering Industrial experience is essential, together with a keen interest in research. Commencing salary £500.

Further particulars may be obtained from the undersigned, to whom three copies of applications with the names of three referees should be sent not later than February 1, 1946.

C. G. BURTON,
Secretary.
The University,
Edmund Street, Birmingham, 3.

PORTSMOUTH MUNICIPAL COLLEGE

Principal: Leonard B. Benny, M.A.

Applications are invited for the post of Lecturer in the Chemistry and Biology Department, capable of teaching these subjects up to and including Intermediate standard. Salary according to Burnham Scale.

Forms of application and particulars may be obtained from the Registrar, the Municipal College, Portsmouth, to whom they should be returned not later than January 5, 1946.

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

HERIOT-WATT COLLEGE, EDINBURGH

PROFESSORSHIP OF PHYSICS

The Governors invite applications from British subjects for the Chair of Physics in the Heriot-Watt College. The Professor is Head of the Department which includes Day and Evening Courses of study. The person appointed will be required to take up duty on September 1, 1946, but consideration will be given to applicants who cannot be released from their present posts until a later date. Teaching experience and works experience in some branch of Applied Physics are desirable. Salary £1,000—£50—£1,200. Particulars may be obtained from the Principal at the College, to whom application should be submitted by April 22, 1946.

J. CAMERON SMAIL,
Principal.

THE QUEEN'S UNIVERSITY OF BELFAST

LECTURESHIP IN PHYSIOLOGY

Applications are invited for the Lectureship in Physiology. The salary attached to the office is £600–£750 per annum with pension under the F.S.S.U., but the commencing salary will depend on the qualifications and experience of the successful candidate. He will be expected to take up duty on October 1, 1946, but if he is on approved National Service he may be allowed to defer doing so until he is released from such duties. Nine copies of applications and testimonials should reach the undersigned on or before March 31, 1946. Further particulars may be had from

RICHARD H. HUNTER,
Secretary.

EAST MALLING RESEARCH STATION

A vacancy for an ENTOMOLOGIST (resident in Scotland) to assist research into the causes and control of crop failure in the Scottish raspberry growing areas, under Special Research Grant, Agricultural Research Council. Research experience in the entomology of field crops essential. Salary according to qualifications and experience, as Scientific Assistant on Ministry of Agriculture Range. Application forms and details from the Secretary, East Malling Research Station, Maidstone, Kent; returnable by January 1, 1946. Applicants still in the Forces will be considered.

EAST MALLING RESEARCH STATION

A vacancy for a HORTICULTURIST to carry out research at East Malling and in Scotland, under Special Research Grant, Agricultural Research Council, into the propagation and cultivation of Small Fruits with particular reference to the Raspberry. An Honours Degree and research experience in some applied branch of Botany advisable. Salary according to qualifications and experience, as Scientific Assistant on Ministry of Agriculture Range. Application forms and details from the Secretary, East Malling Research Station, Maidstone, Kent, returnable by January 1, 1946. Applicants still in the Forces will be considered.

EAST MALLING RESEARCH STATION

A RESEARCH MYCOLOGIST is required to be attached to the Plant Protective Chemistry Section for investigations on laboratory and greenhouse methods for the bio-assay of fungicides. The post will rank either as Scientific Assistant or as Scientific Officer, according to the qualifications and experience of the worker. Application forms and details from the Secretary, East Malling Research Station, Maidstone, Kent, returnable by January 1, 1946. Applicants still in the Forces will be considered.

LONDON HOSPITAL, E.1

There is a vacancy for the post of Assistant Physicist in the Radiotherapy Dept. of this hospital at a salary of £450 per annum. Applications should be addressed to the House Governor.

EAST MALLING RESEARCH STATION

A RESEARCH ENTOMOLOGIST is required to be attached to the Plant Protective Chemistry Section for investigations on laboratory and field methods for the bio-assay of insecticides. The post will rank either as Scientific Assistant or as Scientific Officer, according to the qualifications and experience of the worker. Application forms and details from the Secretary, East Malling Research Station, Maidstone, Kent, returnable by January 1, 1946. Applicants still in the Forces will be considered.

UNIVERSITY OF THE WITWATERSRAND

Applications are invited for five LECTURERS IN ANATOMY. Salary on scale £450 to £650 (plus temporary cost of living allowance). Medical qualification or higher qualification Physics, Chemistry, Botany or Zoology a recommendation. Membership of the University Provident Scheme is compulsory. Applications should be sent by air mail to reach the Registrar, University of the Witwatersrand, Johannesburg, Union of South Africa, not later than January 31, 1945; a duplicate application should be lodged at the same time with the Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1.

UNIVERSITY OF BRISTOL

The University invites applications for the post of LECTURER (Grade II) in PETROLOGY and MINERALOGY. Salary £400 to £550 according to qualifications and experience.

Applications should reach the undersigned, from whom further particulars may be obtained, on or before February 28, 1946. Applications from members of H.M. Forces or from candidates engaged in National Service will be considered.

WINIFRED SHAPLAND,
Secretary and Registrar.

UNIVERSITY COLLEGE OF SOUTH WALES AND MONMOUTHSHIRE

The Council of the College invites applications for the post of Assistant Lecturer and Demonstrator in the Department of Physics at a commencing salary of £400 per annum. Further particulars may be obtained from the undersigned, by whom three copies of applications and testimonials should be received on or before January 15, 1946.

LOUIS S. THOMAS,
Registrar.
University College,
Cathays Park, Cardiff.

UNIVERSITY OF CEYLON

Applications are invited for the CHAIR OF PHYSIOLOGY. Appointment will be for four years in the first instance. Candidates must have medical qualifications as well as special qualifications in Physiology. Salary scale: Rs. 12,000 per annum rising by five annual increments of Rs. 600 and three of Rs. 750 to Rs. 17,250 per annum (£1 sterling—Rs. 13.50).

The Council may appoint at any point on the scale according to qualifications and experience. If the person appointed is not ordinarily resident in Ceylon he will also be paid a rent allowance on the Ceylon Government scale, which is at present 7½ per cent of salary for an unmarried person and 15 per cent for a married person, subject to a certain maximum. The professor will contribute 5 per cent of his salary to the University Provident Fund, and the University will add 10 per cent. Further particulars may be obtained from the Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1.

NATAL UNIVERSITY COLLEGE

PIETERMARITZBURG

Applications are invited for the post of LECTURER IN MATHEMATICS. Salary will be on the scale: Men £450 × £25—£600, women £350 × £25—£500, plus current cost of living allowance. Initial salary will be determined in accordance with the qualifications and experience of the successful applicant. Membership of the University Teachers' Provident Fund is compulsory. Appointment will be in the first instance for a probationary period of one year. Further particulars may be obtained from the Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1.

Laboratory glassblower required for large factory in S.W. London area. Must be experienced in making repair and alteration of all types of laboratory glassware and glass apparatus, including vacuum system and glass-metal seals. Reply stating salary required to Box No. 153, L.P.E. 110, St. Martin's Lane, W.C.2.

Lecturers required for the undermentioned Posts under the Military College of Science, Location: Stoke-on-Trent. LECTURER IN MECHANICAL ENGINEERING. Candidates should preferably hold an Honours Degree in Engineering and have had practical experience in Engineering Works or Research Laboratories, preferably in strength of materials and mechanical design. (Ref. No. C.2931A.) Location: Bury, Lancs. LECTURER IN ELECTRICAL ENGINEERING. Candidates should preferably hold an Honours Degree in Electrical Engineering and have specialised in Light Power Engineering (not Telecommunications). Experience in teaching would be an added recommendation. (Ref. No. D.1557A.) LECTURER IN WIRELESS ENGINEERING. Candidates should preferably hold an Honours Degree in Electrical Engineering or Physics with special qualifications in Telecommunications and have had research, design, or teaching experience in Radar or Telecommunications. (Ref. No. D.1558A.) LECTURER IN INSTRUMENTS TECHNOLOGY (Mechanical). Candidates should preferably hold an Honours Degree in Engineering, Mechanical Science or Physics and have had some experience with firm or institution concerned with design and/or production of mechanical instruments. Experience in teaching would be an added recommendation. (Ref. No. C.2978A.) LECTURER IN INSTRUMENTS TECHNOLOGY (Optical). Candidates should preferably hold an Honours Degree in Physics and have specialised in Applied Optics or had experience with a firm or institution concerned with design and/or production of optical instruments. Experience in teaching would be an added recommendation. (Ref. No. C.2979A.) *Salary*: (All posts), etc. Age 25 and over—on range of £400 to £600 a year plus Civil Service War Bonus at present £60 a year, according to qualifications and experience. Lower rates apply in the case of successful candidates under 25 years of age. It is anticipated that a scale of pay with annual increments and a higher maximum salary than at present offered will be introduced within the next few months. Successful candidates would be required to take up duties as early as possible.

Write quoting appropriate reference numbers to Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, for application form which must be returned completed by January 26, 1946.

Overseas Employment. Wanted by Oil Company in Iraq experienced curator-librarian to take charge of literature and fossil collections in geological laboratory. Salary: £400–£600 p.a. according to qualifications, plus free quarters and certain temporary and variable allowances related to living costs. Age limit 33.

Applications, which must be in writing, stating date of birth, full details of qualifications and experience, including present employment, also Identity and National Service or other registration particulars, and quoting reference No. F.A.158, should be addressed to the Ministry of Labour and National Service, London Appointments Office, 1–6 Tavistock Square, London, W.C.1.

Edit. Secretary required by Publishers; familiarity with Natural History Terminology essential, also shorthand-typing, good organizing ability; must be capable of taking full charge of growing phot. library. Independent, progressive position for right applicant. Box P. 156, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Rubber Research Scheme (Ceylon). The Board of Management requires the services of (1) a MYCOLOGIST and (2) a BOTANIST to undertake research on problems relating to the cultivation of Hevea brasiliensis. Candidates should have University Honours degree and research experience. Salary scale Rs. 7,200—Rs. 600—Rs. 14,400 per annum (present sterling equivalent £540-£45-£1,080) plus a temporary war allowance of 15 per cent. Provident Fund contribution 7½ per cent of salary to which the Board will add a similar amount. Quarters with heavy furniture provided, or equivalent allowance. Initial salary up to the maximum of the scale according to qualifications and experience. In the case of one or other of the appointments the Board would prefer to engage a scientist of high standing and wide experience who could be expected to supervise the work of the Botanical Department. Engagement in the first instance for a period of four years, subject to a termination clause at six months notice after the first two years. First-class passage to Ceylon provided, with return passage and 8 months full pay leave on satisfactory completion of engagement. Leave and travelling allowances in Ceylon in accordance with local regulations.

Write quoting (1) F.5128A, (2) F.5353A, to Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, for application form which must be returned completed, together with copies of testimonials, by January 14, 1946.

Blood Transfusion Service.—Applications are invited from persons with suitable qualifications (scientific and/or medical) for (1) the joint appointment of Regional Director (West of Scotland) and Director of Central Depot (Western Area) at Glasgow, and (2) the joint appointment of Regional Director (South-East Scotland) and Director of Central Depot (Eastern Area) (embodying Plasma Drying Unit) at Edinburgh. Salary for joint position £900–£25–£1,200 in each case. The appointments are on a whole-time basis. It is hoped to arrange for superannuation. In order to allow time for candidates now abroad or in H.M. Forces to apply, the last date for receipt of applications has been fixed at April 20, 1946. "R" practitioners should have obtained the prior consent of the Scottish Central Medical War Committee to their applications. Applications in writing to the Secretary, Scottish National Blood Transfusion Association, 10 Duke Street, Edinburgh, 1.

The British Oxygen Company is planning an expanding programme of research and development, and has openings for research chemists, physicists and engineers for technical planning, and for laboratory and semi-technical experimental work. Previous industrial experience welcomed but not essential, sound theoretical background indispensable. Applications (detailing age, qualifications and experience), which will be treated in confidence, should be made to the Director of Research and Development, The British Oxygen Co., Ltd., Grosvenor House, 6th Floor, Park Lane, London, W.1.

St. Thomas's Hospital Medical School.—Applications are invited for the post of SECRETARY TO THE MEDICAL SCHOOL. Medical qualifications not essential. Salary according to experience and qualifications. Applications, stating age, qualifications, experience, with names of not more than two referees to whom application can be made, to the Dean, St. Thomas's Hospital Medical School, S.E.1, not later than January 31, 1946.

Senior Chemist with practical industrial experience for leading firm of Furskin Dressers and Dyers in London. Graduate in chemistry. Knowledge of Physics, Biology, Textile and Leather chemistry desirable. Good organizer. Age 30 to 40. Commencing salary £1,000 p.a. Box 473, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Oxford Nutrition Survey. An experienced biochemist or chemical analyst, graduate, required immediately for work with nutritional team in Germany. Write giving particulars to the Director, Oxford Nutrition Survey, 10 Parks Road, Oxford.

Oxford Nutrition Survey. Hospital or laboratory technicians required immediately for work with nutritional teams in Germany. Write giving particulars to the Director, Oxford Nutrition Survey, 10 Parks Road, Oxford.

Technical Assistant required for a University Laboratory (in Oxford). Must be a practical man able to assist in the design and construction of various kinds of research apparatus. Experience with electronic equipment is important. Age under 35. Starting wage according to age—£5 4s.—£6 plus war bonus 10s. and family allowances. Box 475, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Assistant Lady Analyst required in Chemical Works, E London. Must have B.Sc. or A.R.I.C. with industrial experience. Write giving details of training, experience, salary, etc., Box ZL.934, Deacons Advertising, 36 Leadenhall Street, London, E.C.3.

Development Chemist required by small manufacturing chemical firm near London. Industrial experience desirable. Products covering most branches of chemicals. Salary in accordance with experience and qualifications. Box 478, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Graduate Chemist (lady) requires position as Scientific Librarian. Experience phys.-chem. research, translating, abstracting, indexing, etc. Box P. 155, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Young man, with common sense, preferably Ex-Service, to accept factory position in well established Photographic Works, with view to training for ultimate responsible position. Some knowledge of chemistry advisable and application for study essential. Write Box 474, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

WANTED: Vacuum Plant complete with Oil Pumps and Heaters, chamber about 12 in. in diameter, suitable for blooming Optical elements. Write price and particulars to Gowllands, Ltd., Morland Road, Croydon.

We purchase Scientific Journals and Periodicals, Learned Society Publications and similar works.—The Museum Book Store, Ltd., 45 Museum Street, London, W.C.1. (Tel.: Chancery 8947.)

Microscopes, of all descriptions, only a few available, second-hand, perfect condition. Send details of your requirements, enclosing 3d. stamp.—Telephone or correspondence only. Chards, Forest Hill, S.E.23 (Spring Park 1628).

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to be three miles apart. One has an area of about one square mile and the other one and a half square miles.

In the past, a great earthquake occurred in the State of Cutch on June 16, 1819. This earthquake caused damage over a vast area and extensive changes in level in the crust of the earth. In Bhuj nearly 7,000 houses were overthrown and 1,140 bodies taken from the ruins. Half the town of Anjar was also destroyed with large loss of life. More recently, earthquakes have also occurred in Baluchistan in 1919 and 1931 (*Nature*, April 27, 1935, p. 661). It appears fortunate that the recent earthquake occurred beneath the sea some miles from land, as otherwise, with a shock so tremendous, without doubt there would have been enormous damage to property and loss of life.

A Biological Council

Many biologists have felt for some time past that the activities of the specialized societies to which they belong remain largely unknown to other biologists who happen to belong to different societies or associations, although often the activities of these other societies are of direct interest to them. The officers of various biological societies have frequently felt the need for more information about the arrangements made by their fellows so as to avoid unnecessary clashes of dates of meetings or duplication of discussions on subjects that might advantageously form the basis of a joint meeting. In an endeavour to provide some common meeting ground for the representatives of the various biological societies, the Committee of the Biochemical Society in the autumn of 1944 called an informal meeting of representatives of a few societies which it was thought might be interested in the proposal. In all, three meetings, attended by representatives of fourteen biological societies, were held afterwards in the rooms of the Royal Society.

It was finally decided that a Biological Council should be formed consisting of the representatives of the various societies which were sympathetic to the scheme. The first meeting of this Council, at which Sir Henry Dale took the chair, was held recently in the Linnean Society's rooms. Dr. W. P. K. Findlay, of the Forest Products Laboratory, Princes Risborough, Dr. W. T. J. Morgan, of the Lister Institute of Preventive Medicine, London, and Prof. J. Z. Young, University College, London, were elected secretaries. While the immediate objects of the Council will probably be limited to such matters as the dates and subjects of the general meetings of societies, it is envisaged that the scope of the Council's work may enlarge and that many editorial and other problems relating to the societies' publications may fruitfully be discussed in common.

Plant Pathology in Palestine

On the occasion of his seventieth birthday in November 1944, Prof. Chaim Weizmann was presented with a volume of researches by members of the Division of Plant Pathology of the Agricultural Research Station, Rehovoth, Palestine. This volume, describing researches carried out under war conditions, testifies to the zeal and energy of the phytopathological staff of the Station. The subjects dealt with cover a wide range, and include diseases of lettuce, beans, cucumbers, tomato, potatoes, citrus, cereals, clover, apple and pear scab, and fungicides. All the papers have since appeared in the *Palestine Journal of Botany*, but the collection brought together is a worthy tribute to a great leader. The remarkable progress in agriculture effected by the Jews in Palestine has no doubt been greatly fostered by the help and assistance afforded by the work of the Agricultural Research Station at Rehovoth. Of the many interesting items mention may be made of four only: a rare parasite of potatoes is constituted by powdery mildew, due to an unidentified species of *Oidium*, which first became epidemic in 1941, and again in 1942 and 1943; the occurrence of the apple and pear scab in all parts of Palestine but on local varieties only, as the European varieties are some weeks later in growth and regularly escape infection; the novel and ingenious suggestion of using the overhead system of irrigation, now largely in vogue in Palestine, for the application of fungicides; and the occurrence of *Ustilago nigra* on barley, the first record of this species of smut outside North America, and of immediate practical importance as this pathogen is susceptible to seed disinfectants.

British Radio Industry

The fundamental scientific principles of radiolocation and the startling results obtained from its application during the War have now become common knowledge. While the conception of this important new weapon is a tribute to British scientific research, and its success in practice demonstrates the ability of the Fighting Services to utilize a highly technical development, there is a necessary intermediate factor, which must not be forgotten, in the form of the design and production facilities available during the time of the country's direst need. The Radio Industry Council has dealt with this last aspect of the subject in a booklet recently issued under the title "The British Radio Industry in War and Peace" (Radio Industry Council, 59 Russell Square, London, W.C.1). The object of this small publication is to tell the world what British men of science, engineers and workpeople have accomplished in the past five years in the application of the whole field of radio technique to war-time requirements, and the manner in which the experience gained during this terrific effort will be applied to the post-war development of broadcasting and television receiver production.

The British radio industry, which in 1935 produced nearly two million broadcasting receivers for ordinary listeners, was the main source of supply of the technical personnel required by the Services during the War to instal, operate and maintain radiolocation and communication equipment. In spite of this loss of some of its most valuable workers, the radio industry was called upon to supply, at high pressure, tremendous quantities of equipment and components of all types. A typical and impressive example of the scale of the radio equipment required is given by the fact that in any one of our thousand bomber raids many thousands of valves, cathode ray tubes and other electronic devices were in the air with those machines; while at the same time there were further very substantial quantities of all kinds of co-operating equipment in use on the ground. The Radio Industry Council has developed largely from the industry's war-time growth, and it is actively engaged in co-ordinating and furthering the interests of the whole radio manufacturing industry through the four independently constituted associations which deal respectively with the manufacture of valves, components, complete equipments and with general radio communications and electronic engineering.

An Abstracting Service for Human Biology

THE trustees of *Biological Abstracts* announce the establishment, beginning in January 1946, of a new section—Section H, specially assembled Abstracts of Human Biology—intended for anthropologists, sociologists, psychologists, neurologists and psychiatrists, students of child development and human welfare, and students of man generally. The new section will be an assemblage of all abstracts published in *Biological Abstracts* dealing with the broad field of human and social biology. Biological studies on human inheritance, population and fertility, endocrine and neurological factors affecting growth, development and human personality, alcoholism and drug addiction, and nervous disorders and mental deficiencies, and broad nutritional and epidemiological studies affecting human welfare, are some of the many fields that will be covered. Further information may be obtained from Mr. H. I. Anderson, Biological Abstracts, University of Pennsylvania, Philadelphia 4, Pennsylvania.

Survival of a Fish after a Major Injury

A POPULAR article by Elizabeth C. Pope in *The Australian Museum Magazine* (8, No. 11, 383) records the survival of a specimen of *Meuschenia skottowei* after the loss (at some previous date in its existence) of three fifths of the tail end of its body. The fish was swimming in the customary position when it was caught in Port Jackson. A photograph of the specimen shows an interesting modification of what, originally, must have been mere remnants of the dorsal and ventral fins. These appear to have grown backwards and round the severed end of the body in order, apparently, to compensate for the loss of the tail as a propelling organ. Dissection showed that the back had been severed clean between vertebræ, and in such a position that little more than the head remained. Most of the gut, though intact, was found to be displaced, and, though the internal organs were crowded, the swim-bladder appeared normal. At least two of the major blood-vessels must have been severed at the time of the accident; but death by hæmorrhage was evidently prevented by crushed tissue sealing the cut ends.

University of London Appointments

DR. KARL MANNHEIM has been appointed to the University chair of education tenable at the Institute of Education as from October 1, 1945. Since 1933 he has been lecturer in sociology at the London School of Economics and since 1941 he has been attached to the staff of the Institute of Education.

Dr. Walter Freudenthal has been appointed to the University readership in dermatological histology tenable at University College Hospital Medical School as from October 1, 1945. Since 1934 he has been research worker and assistant to the Dermatological Department of the School.

The title of professor emeritus in morbid anatomy in the University has been conferred on Prof. G. W. de P. Nicholson, who was University professor of morbid anatomy at Guy's Hospital Medical School during 1922–44.

Dr. D. M. Newitt, reader in chemical technology at the Imperial College of Science and Technology since 1937, and since 1941 director of scientific research of the Inter-Services Research Bureau, has been appointed to the Courtaulds chair of chemical engineering tenable at the College as from October 1.

Dr. Alan Moncrieff, of the Middlesex Hospital and the Hospital for Sick Children, has been appointed to the Nuffield chair of child health tenable at the Institute of Child Health as from January 1, 1946.

Royal Geographical Society Christmas Lectures

THE two Christmas lectures of the Royal Geographical Society will explain in non-technical terms the evolution of survey and map-production methods down to the advances achieved during the War. On December 31, Major C. A. Hart will speak on "Modern Maps and how they are Made", and on January 4, Dr. Edward Lynam, in charge of the Map Room of the British Museum, will deal with some "Early Map Makers", and early methods of surveying from the time of the fourteenth century. The lectures will be supplemented by an exhibition which will be open during December 31–January 5 in the Society's House, Kensington Gore, London, S.W.7.

Physical Society's Exhibition

THE thirtieth Exhibition of Scientific Instruments and Apparatus, arranged by the Physical Society, will be held at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W.7, on January 1 (2.30 p.m.–9 p.m.), January 2 (4 p.m.–9 p.m.) and January 3 (2.30 p.m.–9 p.m.). The leading manufacturers of scientific instruments will be exhibiting their latest products in the Trade Section. The Research and Educational Section will contain contributions from research laboratories, and experiments of educational interest. Discourses will be delivered on January 1 at 5.30 and 8.15 p.m., on "The Optical Industry in the War", by Captain T. Martin; on January 2, at 5.30 and 8.15 p.m., on "Radar", by Sir Edward Appleton; on January 3, at 5.30 and 9 p.m., on "Modern Plastics and Cements", by Dr. J. C. Swallow. Admission to the Exhibition is by ticket only. Members of institutions and scientific societies may obtain tickets from their secretaries; tickets may also be obtained direct from the Exhibition Secretary, 1 Lowther Gardens, Exhibition Road, S.W.7.

Announcements

PROF. ARTTURI VIRTANEN, of the Biochemical Institute, Helsinki, has been awarded the Nobel Prize for Chemistry for 1945.

THE managers of the Royal Institution have appointed Prof. Eric K. Rideal, professor of colloid science in the University of Cambridge, to be Fullerian professor of chemistry in the Royal Institution and director of the Davy Faraday Research Laboratory, in succession to Sir Henry Dale, who retires from both posts on September 30, 1946.

PROF. H. A. KREBS has received a message from Dr. T. Bücher, who worked with Prof. Otto Warburg, stating that Prof. Warburg is alive and well. Apparently Prof. Warburg went to his country house on the Island of Rügen in January 1945, and returned to Berlin in June.

THE foundation members of the newly formed Medical Academy of Sciences of the U.S.S.R. met recently to vote for the first elected members and corresponding members of the Academy. Among those elected to membership were A. E. Braunstein, N. R. Rogansky, R. R. Timofeevsky, P. K. Anochin, D. N. Nasonov and N. F. Gamalea.

LETTERS TO THE EDITORS

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

A Simplified Chemical Notation

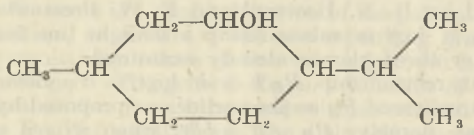
SOME twenty years ago and more I suggested an abbreviated notation to a few chemical friends, who told me that the old method was all they needed, and was too well established to be disturbed. But the thing has recurred to my mind, and I am encouraged to think there may be something in it after all.

Suppose a tetrahedral molecule, with C in the middle, and four H-atoms, not at the apices, but on the *facets* of the tetrahedron; and let us call it A. Lay one such molecule on another; two facets (or two H-atoms) are thereby obliterated. A was CH_4, A_2 is now C_2H_6, and A_n is the whole series of the paraffins. It is obvious, and at the root of the matter, that A, which began as CH_4, may signify CH_3, CH_2, or even C, according to its place in a larger molecule.

Suppose another tetrahedron, on one face of which the H-atom is replaced by —OH, and call it B; this is methyl alcohol, AB is ethyl alcohol, and A_nB is the series of monohydric alcohols. The isomers of these explain themselves; for propyl alcohol (A_2B) may be AAB or ABA, and so on. The primary alcohols are A_nB, the secondaries are A_nA_mB, and the tertiaries are $A_nA_mA_pB$. The polyhydric alcohols have the general formula B_n; glycol is B_2, glycerol is B_3, and so on.

A third tetrahedron (D) has two of the four H-atoms replaced by O; it is formaldehyde, and A_nD is its homologous series. Acetone is formaldehyde to which two methyl groups are added on; its formula is ADA, and that of the higher ketones is A_nDA_m. Formic acid (CHOH : O) becomes a fourth tetrahedron, E; acetic acid is AE, and A_nE is the series of the fatty acids.

To include the nitrogen compounds we use a letter (*N*) for the ammonia radical; methylamine is A*N*, dimethylamine A_2N, and so on; but we must distinguish ethylamine, AA*N*, from A_2N. It will be useful to have a single letter (K) for the benzene ring; but we may deal otherwise with the cyclic compounds. For as A_n represents a linear, or successive, series of methane groups, so let some such symbol as $\{A_n\}$ represent the same in cyclic form. $\{A_6\}$ will represent the single-bonded cyclic C_6H_{12}; and, by a further convention, $\{\{A_6\}\}$ may represent the double-bonded cyclic C_6H_6, that is, the benzene ring itself. As an example of a cyclic formula, take menthol (the alcohol):



This we may now write as $A{\cdot}A\begin{matrix}A{\cdot}B\\A{\cdot}A\end{matrix}A{\cdot}A_2$, or as $A\{A_5B\}A_3$. But enough of examples.

D'ARCY W. THOMPSON.

St. Andrews.

Life-time of the Neutral Meson

THE circumstance that neutral mesons have thus far escaped all attempts at experimental detection can, if one assumes these particles to exist at all, be accounted for by ascribing to them a very short life-time, τ_n, where τ_n refers to the rest system of the neutral meson. In fact, τ_n should be smaller by several orders of magnitude than the corresponding quantity for charged mesons, τ_{ch}.

It has been pointed out by Sakata and Tanikawa[1] that a neutral meson can decay into p photons, $p \geq 3$, a process which gives the desired connexion $\tau_n \ll \tau_{ch}$: for $p = 3$ they find $\tau_n \sim 10^{-16}$ sec. $\sim 10^{-10}\tau_{ch}$. However, the reasoning of these authors would not seem to be conclusive as it involves, contrary to other life-time calculations, the cutting off of a divergent integral, namely, that of the momenta of the protons occupying negative energy-levels. Thus so long as the mystery of the divergences in quantum field theory has not been solved, the above numerical result remains questionable. Therefore, it may be of some interest to inquire whether there is another way of accounting for the short life-time of neutral mesons which does not involve cut-off integrals.

Clearly such a possibility exists: we have merely to assume, first, that in close analogy to the decay of charged mesons, the neutral meson disintegrates according to (the notation will be obvious)

$$Y^0 \rightarrow e^+ + e^- \ , \ Y^0 \rightarrow n + n' ; \quad . \ . \ . \quad (1)$$

secondly, that

$$\frac{g_{ch}^2}{\hbar c} \ll \frac{g_n^2}{\hbar c}, \quad . \ . \ . \ . \ . \ . \ . \quad (2)$$

where g_{ch} (g_n) denotes the strength of the coupling of charged (neutral) mesons with the electron-neutrino field.

In the customary treatments, one puts instead of (2)

$$\frac{g_{ch}^2}{\hbar c} = \frac{g_n^2}{\hbar c} \quad . \ . \ . \ . \ . \ . \ . \quad (3)$$

(which, together with (1), would yield $\tau_n = \tau_{ch}$). The only reason for using (3) is analogy. In fact, relations similar to (3) for couplings of mesons with nucleons are employed in symmetrical theories of nuclear forces, where they find their experimental justification in the charge independence of nuclear forces. But has this analogy any physical background?

The fact that there exists a coupling between the various meson fields and the electron-neutrino field means that there are forces between electron-neutrinos, of the exchange (ordinary) type due to charged (neutral) mesons which can, to a first approximation, be computed by the second-order perturbation formula

$$\sum_i \frac{H_{Ai}\ H_{iF}}{E_A - E_i}.$$

In the nucleon case, the same formula can be used. But whereas it is there possible (to a first approximation with respect to v/c) to neglect the dependence of $E_A - E_i$ on the energy of the nucleons (neglect of recoil), this is impossible in the case of the electron-neutrino because the quanta (virtually) created by the electron-neutrino are heavy compared with the particles by which they are created: the electron-neutrino forces are from the outset relativistic.

This means: (1) there is a dissymmetry between electron-electron and neutrino-neutrino forces on account of the different rest masses entering into the

energy denominator in both cases; (2) comparing a charged with a corresponding neutral interaction of the same strength, that is, using equation 3, it is readily seen that, for similar reasons, another dissymmetry exists, namely, between 'like particle' and 'unlike particle' forces. Therefore we may state that, even if equation 3 holds true, there is in the electron-neutrino case no equivalent of the charge independence of the interaction between nucleons as brought about by a symmetrical theory of nuclear forces.

The situation may thus be summarized as follows: the short life-time of neutral mesons can be explained by Sakata and Tanikawa's process, which means that there is an essential dissymmetry in effects responsible for the decay of charged and neutral mesons respectively. Against this picture objections of principle can be raised (divergences). Alternatively, one can use equation 1, which exhibits symmetry with charged meson decay, and replace equation 3 by 2, which on account of the fundamental dissymmetries of the electron-neutrino interaction is not unplausible. The objections raised against the former treatment, moreover, do not apply here; thus it would seem not inappropriate to suggest this possibility, although it must be admitted that the present discussion, because an *un*observability is at stake, is somewhat academic.

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[1] Sakata, S., and Tanikawa, Y., *Phys. Rev.*, **57**, 548 (1940).

Mechanism of Brittle Rupture

Following the suggestion of one of us (J. B. M.)[1,2] that the decay of strength of glass with time could be explained on the assumption that the glass consists of an elastic matrix containing small pockets of quasi-viscous material, E. Orowan[3] gave an explanation of the process which was compatible with the presence of 'Griffith cracks' in glass.

Since the extension of a crack is an irreversible phenomenon, the process outlined by Dr. Orowan involves a permanent reduction in strength of glass which has been subjected to a stress exceeding the 'wet strength'. To check this experimentally, we have loaded glass rods for 1,000 minutes with a stress sufficient to break about 20 per cent of the rods, and have then compared the strength of the survivors with a group from the same family which had not been subjected to prolonged loading. In order to make the comparison a true one, we discounted the lowest 20 per cent from the group which had not been pre-stressed, to compensate for the 20 per cent which broke in the pre-stressed group during the loading period.

The strength was determined on a standard testing machine which applied a stress increasing at the rate of 0·25 kgm./mm.²/sec., and which was fitted with an automatic cut-off at the instant of breakage. Special precautions were taken to ensure that the same part of the rods subjected to maximum stress during the prolonged loading also received the maximum stress during the standard strength test (the test being of the bending type). The rods had been carefully selected for quality, and were annealed before use; they had also been wrapped at the point of manufacture to avoid scratches. The following table shows the results of the tests.

		Mean breaking stress	Standard deviation
(*a*)	90 rods stressed to 4¼ kgm./mm.² for 1,000 minutes; tested four days after unloading	10·6 kgm./mm.²	1·86
(*b*)	90 rods from same group as (*a*) not subjected to pre-stressing	10·4 „ „	1·90
(*c*)	80 rods stressed to 4¼ kgm./mm.² for 1,000 minutes; tested one minute after unloading	10·2 „ „	1·75
(*d*)	80 rods from same group as (*c*), not subjected to pre-stressing	10·0 „ „	1·82

A difference of 7 per cent in the strength would be statistically significant, and we are therefore entitled to state that there was no permanent reduction in strength exceeding this amount when glass rods were subjected to a stress of 4¼ kgm./mm.² for 1,000 minutes. Since the strength of rods made of this glass falls by as much as 30 per cent when the loading time is increased from 1 minute to 1,000 minutes, it seems that we cannot account for this by the increase in length of 'Griffith cracks'. So far we have not found it possible to reconcile with experimental results any theory about the strength of glass which requires the decay of strength to be due to extension of cracks. This is one of the reasons which led to the suggestion that the decay of strength is connected with the relaxation of a quasi-viscous component of glass, and since this demands that the strength shall be recovered after unloading, due to the recovery of the quasi-viscous component, our experiment supports the theory.

It should also be noted that the theory demands that all glasses shall exhibit a delayed elastic effect, since the quasi-viscous component must cause a delay in the distortion of glass under load; furthermore, since both the delayed elastic effect and the decay of strength are supposed to be due to the relaxation of the quasi-viscous component, there should be a relationship between the rates at which the two effects occur. Experiments designed to test this deduction are now under way; the chief difficulty being that the delayed elastic portion of the deformation of many glasses under load at room temperature is very small, being 1 per cent or less of the total deformation. Preliminary experiments have shown that the strain, σ, may be represented over fairly wide ranges of time by the equation, $\sigma = P(k_1 + k_2 \log t)$, where P is the applied stress, t the time elapsed since loading, and k_1 and k_2 are constants. (A similar equation representing the appearance of strain in glass fibres under load was found to represent experimental results by P. Phillips[4].) It is of interest to note that, on the assumption that the proportion of full-stress concentration achieved at time t is the same as the proportion of full relaxation of a quasi-viscous component at that time, the equation quoted above leads to the expression $P_B'k + k' \log t) = k''$ relating breaking stress P_B with time. It has already been noted by R. N. Haward[5] and F. W. Preston[6] that $1/P_B$ *v.* log$t$ is substantially a straight line for the two or three glasses already examined.

This relationship, $P_B'k + k' \log t) = k''$, yields the same values of P_B as the earlier one proposed by one of us[1], namely, $P_B - a = b/t^{\varkappa}$, when $\varkappa$ is a small number. Over the practical ranges of time available for the experimental work, the two equations lead to almost identical results; but the fact of greatest interest to us at present is the relationship of these results with the delayed elastic effect—a prediction which was made from the suggestion that glass contains a small proportion of quasi-viscous component. This relationship cannot be given accurately until

the experiments on which we are now engaged are completed, but we think the general agreement noted above to be of sufficient interest to report at the present time.

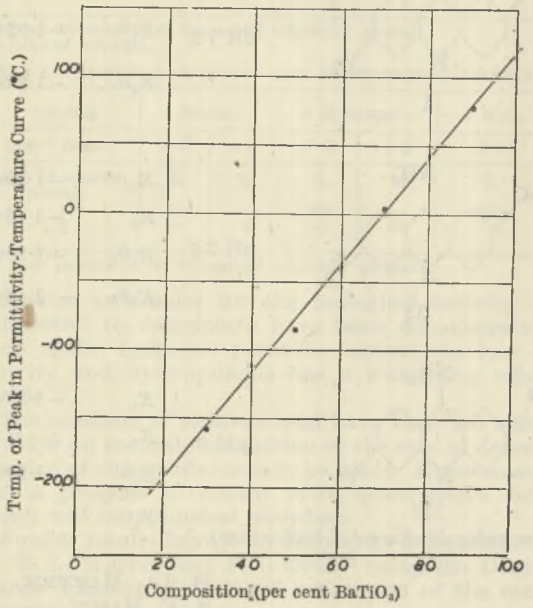
J. B. Murgatroyd.
R. F. Sykes.

Research Laboratory,
Rockware Glass Syndicate, Ltd.,
Greenford, Middx. July 17.

[1] Murgatroyd, J. B., *Nature*, **154**. 51 (1944).
[2] Murgatroyd, J. B., *J. Soc. Glass Tech.*, **28**, 406 (1944).
[3] Orowan, E., *Nature*, 154, 341 (1944).
[4] Phillips, P., *Phil. Mag.*, Ser. 6, **9**, 220 (1905).
[5] See discussion of ref. 2.
[6] Preston, F. W., *Nature*, **156**, 55 (1945).

High Permittivity Crystalline Aggregates

In view of the recent communication by Dr. B. Wul[1], it is desirable to mention that extensive studies of the unusual dielectric properties of a range of titanates of perovskite structure and of related substances have been made by a number of research groups both in Great Britain and in the United States during recent years. We ourselves have been co-operating with the British Pottery Research Association and Dr. W. H. Taylor, now of the Department of Crystallography, Cavendish Laboratory.



The peaked permittivity – temperature behaviour, shown for barium titanate by Dr. Wul, is characteristic of a range of materials. For the solid solution series $BaTiO_3$—$SrTiO_3$, the temperature at which the peak occurs is a simple function of the percentage composition, as shown in the accompanying graph. Peak permittivity values of the order of 10,000 have been obtained. The general shape and height of the peak are similar for all the compositions referred to, so that Dr. Wul's statement "the dielectric constants of the perovskites investigated were found to grow with the increase of size of the alkaline earth ion" is somewhat misleading.

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W. Reddish.

Electrotechnics Department,
University, Manchester.

[1] Wul, B., *Nature*, **156**, 480 (1945).

Autoxidation of Linoleic Acid

In connexion with work on the purification of soybean lipoxidase[1], an investigation was undertaken to identify the primary products formed from linoleic acid when it was oxidized by molecular oxygen with this enzyme or with inorganic catalysts.

In the latter case, methyl linoleate was shaken in oxygen at 37° in diffuse daylight until at most 0·30 mol. oxygen had been absorbed per mol. ester. All absorbed oxygen was present as peroxidic groups (Lea). A strong absorption at 232 mμ appeared during the autoxidation, and increased parallel with the oxygen uptake. The oxidized ester was then directly subjected to chromatographic separation on alumina. Besides unchanged methyl linoleate, two types of peroxides could be separated: (*a*) a more easily eluted mixture of peroxides with a strong ultra-violet absorption ($\varepsilon 232 > 10{,}000$), which on hydrogenation yielded a mixture of primarily monohydroxy-stearic acids; (*b*) a mixture of peroxides with a negligible absorption above 220 mμ, which on hydrogenation yielded a mixture of hydroxystearic acids, that could be split by lead tetracetate. The consumption of the reagent corresponded to a content of 60–70 per cent dihydroxystearic acid (*c*). A ketonic non-peroxidic entity absorbing at 277 mμ was formed during the chromatographic separation and was eluted with the first fractions of (*a*). Both (*a*) and (*b*) had peroxide values (Lea) of 70–100 per cent of that required for a monoperoxide of methyl linoleate.

The amount of (*a*) plus (*c*) was roughly four times that of (*b*). Approximately the same proportions of mono- and di-hydroxystearic acids were formed when the autoxidized ester was hydrogenated directly and the products separated by chromatographic adsorption.

From the hydrogenated products of (*a*), two pure monohydroxystearic acids were isolated. These two acids, provisionally called M_1 and M_2, constitute the main part of this fraction. M_1 (m.p. 75–76°; methyl ester, m.p. 50–52°) and M_2 (m.p. 75–77°; methyl ester, m.p. 51–52°) give large depressions of the melting point when mixed. In order to identify them we are preparing a number of isomeric monohydroxystearic acids and have so far prepared the 10- and 12-isomers, which are not identical with M_1 and M_2.

We have now obtained melting-point samples of the acids (kindly supplied by Dr. Roger Adams, University of Illinois, Urbana, Ill.) prepared by Tomecko and Adams[2]. M_1 has been identified with 13-hydroxystearic acid and M_2 with the 9-hydroxy acid by the mixed melting point of acid and esters. Both give large depressions with the other isomers available.

These results seem to indicate that the oxygen was primarily formed a hydroperoxide group at C_{11} between the double bonds of methyl linoleate (I) in accordance with the theories and results of Rieche, Hock[3], Criegee[4], Farmer[5] and others. The 11-hydroperoxide (II) rapidly rearranged to a mixture of $\Delta^{10:11;\ 12:13}$ 9-hydroperoxido (III) and $\Delta^{9:10;\ 11:12}$ 13-hydroperoxido octadecadienoic acid methyl ester.

I. $CH_3(CH_2)_4CH{:}CH.CH_2.CH{:}CH.(CH_2)_7COOCH_3$
(13) (12) (11) (10) (9)

II. .CH:CH.CH(OOH).CH:CH.

III. .CH:CH.CH:CH.CH(OOH).

IV. .CH(OOH).CH:CH.CH:CH.

V. .CO.CH:CH.CH:CH.

The conjugated double bonds of these rearranged peroxides would explain the appearance of the absorption at 232 mμ and they would on hydrogenation yield 9- and 13-hydroxystearic acid.

The ketonic entity absorbing at 277 mμ that was formed during the chromatographic separation was probably the doubly unsaturated ketone formed from any of these peroxides by dehydration on the alumina, for example, V.

The peroxides in fraction c yielded on hydrogenation high proportion of α-glycolic hydroxy-acids. This might either indicate that the oxygen was to a minor extent directly added to a double bond (cf. Atherton and Hilditch[6]) or that secondary oxidation of the conjugated double bonds had occurred. The point cannot be decided until further work has been carried out on this fraction.

Furthermore, the potassium salt of linoleic acid has been oxidized in aqueous solution with soybean lipoxidase at 37°. Under these conditions one mole of oxygen can be absorbed per mole of acid in a few minutes. From the hydrogenated reaction product 9- and 13-hydroxystearic acids have also been isolated.

The enzymatic oxidation of linoleic acid with lipoxidase thus seems to follow the same course as ordinary autoxidation.

A full report is being published in *Arkiv för Kemi*, Stockholm.

SUNE BERGSTRÖM.

Medical Nobel Institute,
Department of Biochemistry,
Stockholm.
July 25.

[1] Theorell, Bergström and Akeson, *Arkiv Kemi, Min. Geol.*, 19 A, No. 6 (1944).
[2] Tomecko and Adams, *J. Amer. Chem. Soc.*, 49, 522 (1927).
[3] Hock, *et al.*, *Naturwiss.*, 24, 159 (1936); *Ber. deut. chem. Ges.*, 66, 61 (1933); 71, 1430 (1938); 72, 1562 (1939); 76, 169, 1130 (1943).
[4] Criegee, *Ann. Chem.*, 522, 75 (1936); *Ber. deut. chem. Ges.*, 72, 1799 (1939).
[5] Farmer, *et al.*, *Trans. Faraday Soc.*, 38, 340 (1942); *J. Chem. Soc.*, 119, 122, 541 (1943).
[6] Atherton and Hilditch, *J. Chem. Soc.*, 105 (1944).

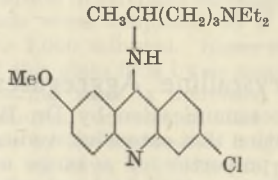
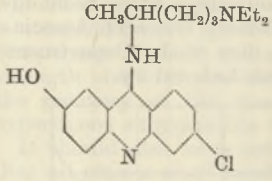
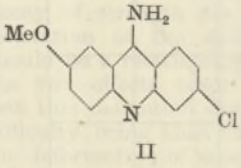
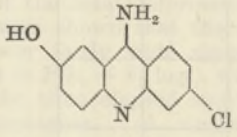
Primary Degradation Products of Mepacrine in Human Urines

IN a previous note[1] it has been reported that 2-chloro-5-amino-7-hydroxyacridine is to be found in the urines of mepacrine-taking subjects. We have now subjected such urines to a separation technique based on that applied by Scudi and Jellinek[2] to the urines of dogs.

After chromatographic purification on alumina and elution with water or dilute acid, we have obtained solutions in which we have been able to demonstrate the presence of the compounds 2-chloro-5-amino-7-methoxyacridine (II) and 2-chloro-5-(δ-diethylamino-α-methylbutylamino)-7-hydroxyacridine (I), as well as 2-chloro-5-amino-7-hydroxyacridine (III). These compounds have been identified by measurements of their half-wave (reduction) potentials, in buffered solutions, by means of the Cambridge polarograph and comparison with the potentials of authentic specimens determined under similar conditions.

Fuller details of the work will be published elsewhere; in the meantime, we select data sufficient to establish the correctness of our conclusions. It will be noticed that the diagnostic value of the half-wave potential is considerably enhanced by the fact that acridines show two stages in polarographic reduction, each of which, at a particular *p*H, is characteristic of the particular derivative.

Below we give, as E_1 and E_2, the half-wave potentials of the respective acridine derivatives, the first being mepacrine itself. E_1A, E_2A, E_1B_1, etc., refer to the potentials of the urinary products obtained from the fractions *A*, B_1, B_2 and *C* of the Scudi and Jellinek procedure (*loc. cit.*).

Compound	Buffer *p*H	Half-wave potential	
 Mepacrine	*p*H 7·3	E_1	−1·12v.
		E_2	−1·41v.
		E_1A	−1·12v.
		E_2A	−1·41v.
 I	*p*H 7·3	E_1	−1·02v.
		E_2	−1·27v.
		E_1B_1	−1·02v.
		E_2B_1	−1·28v.
 II	*p*H 7·3	E_1	−1·20v.
		E_2	−1·43v.
		E_1B_2	−1·20v.
		E_2B_2	−1·43v.
 III	*p*H 9	E_1	−1·20v.
		E_2	*p*
		E_1C	−1·20v.
		E_2C	*p*

(*p* = prior discharge of buffer ions)

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[1] *Nature*, 154, 461 (1944).
[2] *J. Biol. Chem.*, 152, 27 (1944).

Instability of Dienœstrol and Stilbœstrol Solutions

WHILE investigating the metabolism of synthetic œstrogens, we encountered anomalous results during assays of œstrogenic potency which led us to believe that dienœstrol was unstable in solution. Serial assays carried out on standard solutions of dienœstrol and stilbœstrol have shown the supposition to be correct.

Solutions of dienœstrol (1 μgm. per ml.) were prepared in distilled water, $N/500$ hydrochloric acid, and $N/500$ caustic soda, and assayed at intervals according to the standard method of this Institute (twice-daily injections for three days into groups of 10–20 spayed rats and recording the proportion that go into œstrus or full pro-œstrus within two days of the last injection). The results in Table 1 show that the acid and alkaline solutions deteriorated more rapidly than the neutral solution. Polymerization is a possible explanation of the change, and this suggestion is supported (though not proved) by the facts that the loss of activity in a neutral solution of dienœstrol is greatly hastened by the addition of a trace of hydrogen peroxide but is inhibited by the addition of hydroquinone (1 μgm. per ml.). The doses used for the assays have been high—3 μgm., representing three to six times the ED 50 for dienœstrol.

TABLE 1. RESPONSES OF SPAYED RATS TO DIENŒSTROL SOLUTIONS.

Solution	Neutral		Acid		Alk.		+ Hydroquin.	+ H_2O_2
Dose* (μgm.)	1·0	3·0	1·0	3·0	1·0	3·0	0·7	3·0
Age of solution (weeks)	%	%	%	%	%	%	%	%
1	40	—	10	–	0	–	70	0
2	—	100	—	0	–	0	—	–
3	—	—	—	0†	–	0†	40	–
5	0	100	—	–	–	–	—	–

* Dose calculated on dienœstrol originally present.
† Dose of 6·0 μgm.

TABLE 2. RESPONSES OF SPAYED RATS TO STILBŒSTROL SOLUTIONS.

Solution	Neutral		+ Hydroquin.		+ H_2O_2
Dose* (μgm.)	0·3	0·4	0·3	0·4	0·5
Age of solution (weeks)	%	%	%	%	%
1	10	—	40	—	100
3	—	0	—	80	0

* Dose calculated on stilbœstrol originally present.

Similar tendencies for the biological activity of stilbœstrol to deteriorate have been demonstrated. Here again, hydrogen peroxide hastens the loss of activity and hydroquinone has a stabilizing effect (Table 2).

The numbers of animals used have been too small to allow an accurate estimation of the rate of decomposition of either substance to be made. Experiments are in progress to obtain more quantitative data which will be published elsewhere.

Similar results have been arrived at independently by F. L. Warren and F. Goulden[1] using the Dingemanse[2] method of chemical estimation of the compounds.

These facts mean that the results of assays made on dienœstrol or stilbœstrol solutions that are not freshly prepared will be low, as will be estimates of the excretion of these compounds where their instability in biological liquids has not been taken into account. Although it is not expected that solutions of natural œstrogens or of hexœstrol will show similar changes, their stability is also being investigated.

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[1] Warren, F. L., and Goulden, F., [*Proc. Biochem. Soc.* (Sept. 28, 1945)].
[2] Dingemanse, E., *Acta brev. neerl.*, **9**, 118 (1939).

Parathyroidectomy and Lactation in the Rat

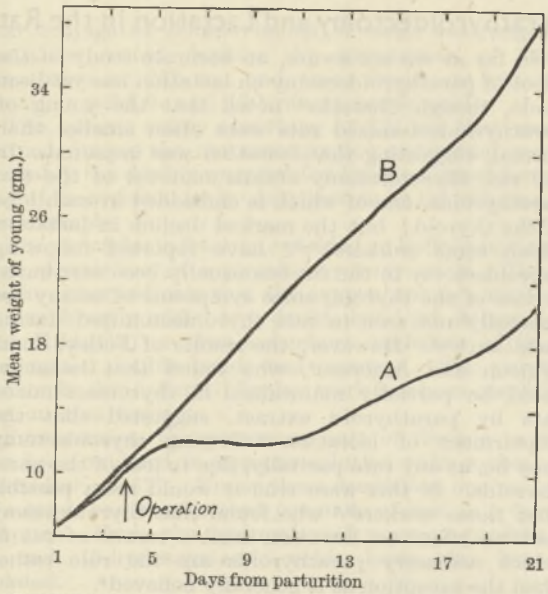
So far as we are aware, no accurate study of the effect of parathyroidectomy on lactation has yet been made, though Chandler[1] noted that the young of parathyroidectomized rats were often smaller than normal, suggesting that lactation was impaired. In the rat, thyroidectomy entails removal of the two parathyroids, one of which is embedded in each lobe of the thyroid; but the marked decline in lactation which some workers[2,3,4,5] have reported following thyroidectomy in the rat has usually been attributed to loss of the thyroid, since symptoms of tetany are generally not seen in rats thyroidectomized during lactation[2,4,5]. However, the results of Folley, Scott Watson and Amoroso[5], who found that lactation could be partially maintained in thyroidectomized rats by parathyroid extract, suggested that the impairment of lactation following thyroidectomy may be, at any rate partially, due to loss of the parathyroids. If this were true it would seem possible that those workers[6,7] who found that thyroidectomy had no effect on lactation used a strain of rat in which accessory parathyroids are the rule rather than the exception as is generally believed[8].

We have recently had an opportunity of investigating directly the effect of parathyroidectomy on lactation in the rat, using rats from the same colony and similar experimental methods as in previous lactational studies[9]. Six normally lactating rats were parathyroidectomized on the fourth day of lactation by a technique slightly modified from that of Richter and Birmingham[10]; three control rats were subjected to a sham operation. The growth-rates of the litters of all except one of the parathyroidectomized rats underwent a marked decrease soon after the operation (see graph and table). In constructing the growth-curve reproduced, the data for the litter of the exceptional rat, which continued to grow at a normal rate (see table), were omitted.

Treatment	No. of rats	No. of young on 4th day of lactation ♂	♀	Mean wt. of young (gm.) on day of lactation 4	15	21	Percentage of young alive on day of lactation 4	15	21
Sham operation	3	12	12	10·9	27·8	38·4	100	100	100
Parathyroidectomy	5	28	10	10·2	15·4	20·9	100	87	84
Parathyroidectomy (rat with presumed accessory parathyroids)	1	4	4	11·5	29·9	44·0	100	100	100
Thyroidectomy*	6	19	25	10·0	13·4	19·0	100	89	66

* Data from Folley[2].

Owing to the fact that these were surplus rats from another experiment, it so happened that one of the control and two of the parathyroidectomized rats received a high-protein diet, which we have found to exert a slightly deleterious effect on lactation, while the rest received the normal stock diet[9]. Analysis of the results for individual rats clearly showed, however, that this factor had no effect on the conclusion to be drawn from this experiment, namely, that parathyroidectomy caused a marked decline in, but not complete cessation of, lactation. This conclusion is, of course, as in all experiments of this nature, subject to the proviso that the only criterion at present available for measuring the milk yield of laboratory rodents—the growth-rates of litters—is a valid one.



CURVE *A*: GROWTH-CURVE OF THE LITTERS OF FIVE PARATHYROIDECTOMIZED RATS; CURVE *B*: GROWTH-CURVE OF THE LITTERS OF THREE SHAM-OPERATED CONTROLS.

At the end of the experiment the rats were killed and the thyroids sectioned serially and examined for parathyroid tissue. None was found in any parathyroidectomized rat, including the anomalous animal. It seems reasonable to assume that this rat alone of the group possessed sufficient accessory parathyroid tissue to support normal lactation. In this connexion it may be recalled that accessory parathyroids were previously found in 17·2 per cent (approximately 1 in 6) of a group of rats from the same colony[5]. In accordance with previous findings with thyroidectomized rats, no symptoms of tetany were seen in these rats after parathyroidectomy.

There is some evidence (see table) that the effects on lactation of parathyroidectomy are scarcely less severe than those of thyro-parathyroidectomy[2]; but it would not be safe to conclude that the loss of the thyroid alone would have no influence on milk-yield, since more complete inhibition of lactation following thyro-parathyroidectomy was noted in a subsequent experiment[5], in which, however, the growth of the young prior to the operation was slightly sub-optimal. It is planned to investigate this aspect of the subject further.

We are indebted to the Agricultural Research Council for a research grant to one of us (A. T. C.), and to Dr. S. K. Kon for the facilities of his rat colony.

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[1] Chandler, S. B., *Anat. Rec.*, **53**, 105 (1932).
[2] Folley, S. J., *J. Physiol.*, **93**, 401 (1938).
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[7] Nelson, W. O., *Amer. J. Physiol.*, **126**, P592 (1939).
[8] Hoskins, M. M., *Endocrin.*, **15**, 324 (1931).
[9] Cowie, A. T., and Folley, S. J., *Yale J. Biol. Med.*, **17**, 67 (1944).
[10] Richter, C. P., and Birmingham, J. R., *Endocrin.*, **29**, 655 (1941).

Nature of the Gram-positive Complex in Micro-organisms

IN a previous communication[1] it was suggested that the Gram-positive material in micro-organisms is a high-molecular complex formed by the combination of a reduced basic protein in the cell cytoskeleton with magnesium ribonucleate. We have now succeeded in extracting from various organisms the Gram-positive complex which has the essential characteristics of a magnesium-containing nucleoprotein, the protein constituent of which appears to be of a novel type and to differ particularly from known histones and protamines. All attempts, using methods described in the literature[2,4], to extract basic proteins of the histone or protamine type from the highly resistant cell cytoskeletons failed to yield more than traces of compounds having a high-basic amino-acid content.

The method of obtaining the complex from Gram-positives involved a relatively short autolysis of the cells at *p*H 8 and 37°, followed by adjustment of the centrifuged supernatant to *p*H 5, at which point a precipitate was thrown down. This consisted of nucleoprotein which was purified by reprecipitation methods and when fixed on a slide stained intensely Gram-positive. The dye-retaining nucleoproteins from yeast and *Cl. welchii* have been examined in some detail. The material from yeast readily dissolved in aqueous solution at *p*H 7 had N, 14·3; purine N, 2·9; P, 2·6; ribonucleic acid, *c.* 25 per cent, and contained —SH groupings. On heating a neutral aqueous solution of the nucleoprotein at 60° for a short time, the protein constituent came down in denatured form leaving the nucleic acid in solution, a phenomenon which resembled the behaviour of Cohen and Stanley's[3] tobacco mosaic virus ribonucleoprotein. By a relatively simple procedure it has been possible to dissociate the protein from its combination with nucleic acid and to obtain both constituents in a reasonable degree of purity. The nucleic acid was entirely of the ribo-type. The protein, isolated in the form of its soluble hydrochloride, was free from phosphorus and pentose, and had N, 14·3; arginine, 5·5 per cent; it was readily denatured on being dried or heated. Neither the protein nor the nucleic acid alone could be stained by Gram's method; but on re-forming the complex at *p*H 5, preferably in the presence of magnesium ions and formaldehyde, it again stained strongly Gram-positive. The Gram-positive nucleoprotein from *Cl. welchii* closely resembled the yeast product in general properties. Thus, it was soluble in water at *p*H 7, had N, 14·9; purine N, 2·9; P, 2·5 and contained Mg and —SH groups. It was, however, more difficult to separate into its protein and nucleic acid, while the latter had the important difference in that it contained the deoxy- (3·5 per cent) as well as the ribo-type (27 per cent). The dissociated protein constituent had N, 14·3 per cent, and contained —S—S— links.

In order to examine the dye-retaining properties of protein nucleates stained by Gram's method, a number of 'artificial' complexes were made by adding basic proteins such as protamine salts to magnesium nucleates at *p*H 6–7, whereby precipitates containing both protein and nucleic acid were thrown down. Typical nucleates made were protamine ribonucleate, clupeine ribonucleate, histone ribonucleate, histone deoxyribonucleate, etc. When stained, certain of these, particularly the histone deoxyribonucleate, retained in some measure the basic dye; but in general

the results were unsatisfactory, and the stained preparations were not comparable with the intensely stained bacterial nucleoproteins. It was clear that in the Gram-positive complex the linkage of the protein with the ribonucleic acid is not of the simple electrovalent type, and the mechanism of the retention of the dye is more fundamental than its mere combination with a basophilic salt-like molecule; sulphydryl groups and magnesium ions do appear to play an important but as yet undetermined part.

So far we have not been able, by using an analogous autolytic procedure, to obtain nucleoproteins from Gram-negatives. By chemical extraction methods, however, using bile salt derivatives, saline, etc., we have obtained nucleic acids of both ribo- and deoxyribo-types from certain Gram-negatives. Some fractions contained both proteins and nucleic acids, and when solutions of these were adjusted to *p*H 5, there separated protein nucleates which were able to retain the Gram stain in a manner comparable with that described above for the 'artificial' protein nucleates. Thus it appears that this amount of dye-retaining character is a non-specific property of such salts which, as isolated from Gram-negatives, we regard as artefacts. It was also of interest to note that, in the Gram-negatives so far examined, the ratio of deoxyribonucleic to ribonucleic acid is considerably higher than in Gram-positives. Thus we consider that there are fundamental differences between the basic proteins of Gram-positives and Gram-negatives, and between their mode of combination with nucleic acids; so that an understanding of these is desirable in order to give an insight into the mechanism of the selective attack of some antibiotics.

Mirsky[4] has pointed out that in deoxynucleohistones the nucleic acid content is about 40 per cent, whereas in ribonucleoproteins it is of the order of 10 per cent. It will be noted that in our Gram-positive ribonucleoproteins the amount of ribonucleic acid (25 per cent) falls midway between the two, and it is possible that the protein constituent represents one type of cytoplasmic protein of which but little is yet known. Moreover, this protein appears to differ from that of the histone or protamine type which was obtained from pneumococcal nucleoprotein[5].

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[1] Henry and Stacey, *Nature*, **151**, 671 (1943); *Proc. Roy. Soc.*, B, in the press.
[2] Kossel, "The Protamines and Histones" (Longmans, 1928).
[3] Cohen and Stanley, *J. Biol. Chem.*, **144**, 589 (1942).
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Late Flowering of Horse-Chestnut

Dr. Julian Huxley's letter[1] describing the late flowering of horse-chestnut in Paris this autumn brought back to me a vivid memory of autumn 1912. I turned up my youthful diary and found this entry: "Paris, 3rd September, 1912. The trees are in a queer state here; the old leaves are dead and falling as in autumn and at the same time new shoots and flowers are borne on the same trees, particularly on the horse-chestnuts in the Champs Élysées." There are few records of weather in the diary but an earlier entry of the same day reads: "We went through the Luxembourg Gardens where the lawns were being watered! (the first time I have seen grass watered this year!)". And on the day before, it had seemed worth while to enter: "It rained a little".

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[1] *Nature*, **156**, 574 (1945).

The publication of the note by Dr. Julian Huxley prompts me to record some observations of a similar phenomenon in 1944.

At the beginning of October flowering was noticed on a tree of *Aesculus hippocastanum* at Twickenham, Middlesex, in circumstances similar to those described by Dr. Huxley. This tree had been damaged severely by the frosts of May 3–8. The opportunity was taken of comparing its behaviour with that of two trees of the same species in Sunbury-on-Thames which were defoliated almost completely by blast from a flying-bomb in early August. They were in flower for the first three weeks of October until the blossoms were killed by frost. Small fruits were formed but did not mature. These dates are later than those commented upon by Dr. Huxley.

In 1945, the three trees mentioned produced fewer leaves than usual and very few inflorescences. Most of the buds containing inflorescences must have been used in the autumn flowering.

It is interesting that, although the defoliation of the frost-damaged tree was in May and the bomb-damaged trees in August, all were in flower together in October. Similarly the trees observed by Dr. Huxley were damaged in spring but did not flower again until the autumn, the buds opening at the usual time for leaf-fall.

The mild autumn weather experienced in 1944 may be connected with the second flowering, as this was seen, also, at Sunbury-on-Thames in a species of *Aesculus carnea* Hayne which was not noticed to be damaged in May. It would appear that it is the already defoliated condition of the trees of *Ae. hippocastanum* at the usual time for the commencement of leaf-fall which stimulates the opening of the buds at that time, the production of new leaves and inflorescences in the buds proceeding at the same rate during the summer whether mature leaves are present or not. A comparison between the autumn condition of such a tree and that of a normal tree in the similar temperature and light conditions of spring is tempting.

In view of the fact that some of the species of *Aesculus* flower normally as late as August it would be interesting to observe the behaviour of those trees of European, Asiatic and American ancestry which are collected close together, in virtually the same environment, at the Royal Botanic Gardens, Kew, in any season when second flowering takes place.

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THE INDIAN STATISTICAL INSTITUTE

THE continued activity and growth during the war period of the Indian Statistical Institute is a striking example of the benefits which may flow from the stimulus of war conditions, when individual initiative is unhampered in putting itself at the service of Government and to meet the needs and deficiencies of existing official organization. Perhaps nowhere than in India have the prevailing conditions been more propitious, or the need greater, for the active use of agencies run at private risk for public purposes.

The Institute, as it has now developed, has many facets: on the educational side equally as a training ground for computors and routine statisticians, and as a centre of postgraduate research in the most far-reaching branches of the mathematical theory of statistics and experimental design; as a professional institute and learned society bringing together all schools of thought in Indian statistics; as an agency employed by departments of Government and advisory bodies, in the essential work of collecting, scrutinizing and digesting the facts upon which administrative decisions must depend. The achievement of co-operation among the many able men needed to guide these various activities has been the work of an applied mathematician, Prof. P. C. Mahalanobis, formerly professor of physics, acting as honorary secretary to the Institute. He was this year elected fellow of the Royal Society.

There can be no doubt that accurate knowledge by the Government of Bengal of the amount of rice available in the Province would have obviated the food crisis of 1943, in which approximately one million lives were lost, by forestalling panic and cutting the ground from under the food speculators. The story is told in the report for 1943–44:

"The most notable progress in the year under review was achieved in the sample survey of crops. It would be remembered that work was started on a small scale with a total expenditure of about Rs. 7,000 on an exploratory survey of the jute crop in Bengal in 1937. This was the beginning of a five-year scheme for the improvement of jute statistics which was financed jointly by the Indian Central Jute Committee and the Government of Bengal. The sampling technique, developed in the course of a gradually expanding series of surveys culminating in the full scale provincial work of 1941, which demonstrated beyond dispute the possibility of securing by this method a final estimate of jute acreage with a margin of error of only two or three per cent at a cost of one-fifteenth or one-twentieth of that of a complete enumeration. A general account of the five-year scheme with discussion of theoretical foundations was given in a memoir prepared by the Hon. Secretary in 1942 which is being published in the *Philosophical Transactions* of the Royal Society of London.

"The Hon. Secretary had been pressing from the very beginning of the five-year scheme in 1937 for the extension of the method to cover paddy and other important crops in Bengal. Each year from 1938 to 1942 he repeated his efforts but without success. In 1942 the Indian Central Jute Committee had expressed their complete satisfaction with the method of the sample survey and had recommended its continuance by Government in future. The Government of Bengal however decided at first to discontinue the work but subsequently revoked their decision and asked the Hon. Secretary at the end of March 1942 to proceed with the Jute survey. By this time a good portion of Burma had been occupied by the Japanese, and the supply of rice from that country had been cut off. Apprehending a serious deterioration in the food situation (not because of the physical volume of the import which was small but because of the possible effect on prices) the Hon. Secretary submitted a definite scheme to the Government of India at the end of March 1942 for extending the sample survey to cover the paddy crop in Bengal. In the course of the next few months he also discussed the question with a large number of officials in Bengal but all his efforts failed completely. In the absence of reliable statistics both the provincial and the Central Governments were left entirely in the dark regarding the supply position of rice at the end of 1942. This made it impossible for Government to pursue a consistent food policy on any objective basis. The weakness of the statistical position was thus an important factor in bringing about the deplorable food crisis in Bengal in 1943."

It was not, therefore, until after the famine that the Institute was enabled to show what its organization could do with the immense problem of sampling the 70,000 square miles of agricultural Bengal. Adequate accuracy in areas under crops is much more difficult to attain than is yield for unit areas. Some 59,000 grids each of 2·25 acres, chosen on a system of stratified random sampling, were needed for Bengal, the whole being divided into zone cells of sixty-four square miles and sub-cells of one square mile, approximately the area occupied by a single village. A feature of great importance for Indian conditions, and worthy of study elsewhere, is the duplication of the system in interpenetrating networks, so that entirely independent pairs of estimates are available for each area. This not only facilitates the administrative checking of gross negligence, or misunderstood instructions, but also enables the precision of the final estimate to be assessed as it really is by including all causes, human as well as physical, which contribute to inaccuracy in the result.

There is perhaps no other organization in which practical and theoretical work are more thoroughly integrated. The combinatorial investigations of R. C. Bose and A. Bhattacharya and the studies of multivariate distributions of Mahalanobis and S. N. Roy supply not only the general plan but also very detailed guidance to the two hundred or so workers of the field and computing staffs.

EXCAVATIONS AT HYRAX HILL, NAKURU, KENYA COLONY

ALTHOUGH uncertainties in detail may still exist, the general structure of the prehistoric story of Kenya as laid down by Dr. L. S. B. Leakey is now accepted by most prehistorians. The various climatic changes that have occurred and their correlations with the more important cultures found are also clear. Following on a major pluvial phase called Gamblian and correlated with the Kenya upper palæolithic, there were two merely wet phases separated by a dryer period. These are known respectively as the Makalian and the Nakuru wet phases. They are post-palæolithic in age, and the latter is not of great antiquity.

Mary D. Leakey, in a paper entitled "Report on the Excavations at Hyrax Hill, Nakuru, Kenya Colony, 1937–1938" (*Trans. Roy. Soc. S. Africa*, **30**, Pt. 4), describes excavations made at sites on an eminence which was under water during the period covered by the last major pluvial (Gamblian), and along the sides of which occur beach-levels of the subsequent wet phases. Correlation of the archæological and geological records is therefore simple. A number of sites, including some stone-walled enclosures and a low mound, were investigated, as well as a group of pit dwellings. There were found : (1) a neolithic occupation site and cemetery, (2) a Gumban (neolithic) pit-dwelling village, and (3) a later, probably not very ancient, level connected with the stone-walled enclosures and associated burial pits and with an industry which shows the influence of Arab traders.

The neolithic occupation site lies on the 335-ft. beach (Makalian) and is therefore subsequent to its formation ; the Gumban pit-dwelling is somewhat younger in age and contains an industry (Gumban *B*) which is well known elsewhere and has been assigned to the maximum period of the later (Nakuru) wet phase. From the earlier neolithic levels there were brought to light no less than eighteen skeletons—a number female—in contracted burials. These are described in detail by Dr. Leakey.

The associated industry clearly shows its upper palæolithic origin, for it must be remembered that in East Africa there were no devastating climatic changes of the magnitude of those which obtained in Europe ; cultures were not swept away but ripened and went to seed ; the past continued to influence the growth of the present much more than was the case in Europe. Thus in the levels above mentioned, there were found a whole series of obsidian tools clearly derived from normal Kenya upper palæolithic types. In the Gumban levels there were stone bowls and pottery typical of the Gumban *B* neolithic.

The report contains 409 pages and is well illustrated. All concerned in the post-palæolithic cultures of Kenya will find it very interesting.

M. C. Burkitt.

AUTOMATIC CONTROL AND RECORDING IN CHEMICAL AND OTHER PROCESSES

THE Institution of Chemical Engineers, the Institute of Physics and the Chemical Engineering Group of the Society of Chemical Industry made arrangements more than a year and a half ago to hold a joint conference in the autumn of 1944 on recording and controlling in the chemical industries. The incidence of flying bombs and of rockets, however, made it inadvisable to gather together a large number of key technicians in London at that time, and the conference was postponed indefinitely. This has proved to be a fortunate circumstance ; for the conference was held on October 19 of this year, when the industries interested were not completely occupied with war-time requirements, but were turning their attention once again to the problems of ordinary commercial production. In consequence, the conference has been held at a time when industry is not merely aware of certain technical deficiencies but also is actually planning to do everything possible to overcome them. That the subject of the conference is of vital interest to the chemical industries, as indeed it is to all industries, was shown by the remarkable attendance, the lecture theatre at the Royal Institution being filled and almost over-filled. Apart from all other benefits which accrue from a conference of this kind, the personal contacts which are made between the makers and users of instruments provide ample justification for holding it, and it was a happy thought on the part of the organizers to arrange that the instrument firms should hold private exhibitions of their instruments on the following day.

In the opening address to the conference, given by the president of the Institute of Physics, Sir Frank Smith, two main points were made. The first was the interesting one that although in industry the scientific instrument is usually regarded as the handmaiden of industrial processes, experience shows that the emergence of a new type of instrument has often been responsible for the birth of a new industry. There is, for example, a great industry now in existence catering for the requirements of radar, and it is indisputable that radar, and the industry associated with it, could not and would not exist unless an instrument were available for measuring time intervals smaller than one millionth of a second. Some decades ago, Sir J. J. Thomson devised the first instrument capable of achieving such measurement. This was the cathode ray tube, which later became the cathode ray oscillograph. Without this instrument, and without also the wireless valve which was a development of an instrument (the one-way rectifier of Sir Ambrose Fleming), there could not have been any radar nor, in consequence, the great new industry which has developed around it. Equally spectacular examples could be cited; but it is probably true that nearly every big advance in industry has been the result of knowledge obtained in the first place by the use of a new instrument. There is, therefore, every incentive for industry to be instrument-conscious, apart from that arising from the benefits obtained by the use of instruments which is ancillary to industrial processes.

Britain has been warned, and is acutely aware, that the maintenance of its standard of living is dependent upon an increased export trade. The achievement of an increased export trade is dependent upon our ability to produce articles of exceptional and standard quality at competitive prices. The material articles which can be exported can be classed either as special products or as articles capable of being produced by mass-production methods. It is in the production of this latter category that a realization of the necessity of industrial instrumentation is essential. Only by the complete control of processes can an exceptional quality of product be made standard, and only by the avoidance of waste and the lowering of costs resulting from control can competitive prices be offered.

In some general observations on the use of recorders and controllers, the director of the British Scientific Instrument Research Association, Mr. A. J. Philpot, pointed out that the general industrial structure of Britain, with its preponderance of relatively small concerns, has been favourable to the creation and maintenance of a system based on the maximum use of individual craftsmanship and a large exploitation of personal knowledge and experience. Such a system served us well during a long period when industrial processes were relatively

static; but the tempo of industrial progress has so increased, and the changes in industrial methods have become so rapid, that it is now essential that scientific investigation and observation should permeate the day-to-day carrying out of processes, and that in any industrial concern the appropriate knowledge must exist which will enable rapid and useful application to be made of any relevant advances in applied science. The use of instrument recorders and controllers is the prime means of ensuring that such observation and such accumulation of knowledge can be made.

There is little virtue in the mere installation of instruments unless steps are taken to see that the scientific method shall be applied to their use; the installation of instruments may eliminate a large amount of human error, but the whole purpose of the instruments may be defeated unless they are in the charge of technicians who understand the principles of their working and fully appreciate the existence of instrumental errors, which may vary from day to day and with changing physical conditions. Since recorders and controllers are based on physical principles, it would seem logical that the wide introduction of these instruments into industry should be accompanied by an extended use of physicists by industry. It is doubtful whether enough physicists exist to fulfil the requirements of industry, and, in any event, it may well be that the physicists required should have some special instruction and practical technical experience outside the normal university course in physics. While it is to be hoped that facilities for technical education of this type will be available in the future, every encouragement should be given to the younger technical personnel in industry to take advantage of the newly established courses for national certificates in applied physics.

The use of automatic control in the oil industry and in the pasteurization of milk were the subjects of papers by Mr. D. J. Pull and Mr. R. A. Hill, both of which were largely factual statements of the actual systems of automatic controls used in these two spheres. The diverse nature of control is well illustrated by the use of instruments for these two purposes. In the oil industry, when conditions have been achieved such that optimum results are obtained, the paramount need is for a system of control which will prevent any departure from these conditions. An absolute knowledge of, for example, the exact temperatures employed is of secondary importance compared with the rigid maintenance of these temperatures, as only thus can the production of a standard material be assured. In the pasteurization of milk, both an exact knowledge of the temperature and the maintenance of this temperature are essential, since the nutritive value of the milk, and the effectiveness of pasteurization achieved, are vitally dependent upon these factors. The chemical processes of the oil industry are extremely complicated and tend to become progressively more so; and it is evident that the development capacity of instrument manufacturers will be severely strained if instrument design is to keep pace with the control requirements of the industry.

It is perhaps unfortunate that the operation of a controlling mechanism appears to be simple and inexorably exact. The statement, however, that any physical phenomenon, the action of which can be measured, can be used to operate a controller which in turn limits the extent of action of the phenomenon, while generally true, gives no indication of the complications which are inherent in any controlling instrument. This point was well illustrated in the papers of Prof. K. A. Hayes and Dr. G. D. Prinz, which dealt with the mathematical analyses involved in studying the characteristics of control systems and of the stability of such systems. The growth in use by industry of what is commonly called instrumentation has been exceedingly rapid, and it is not generally recognized that there is involved in this instrumentation a new branch of technical science, and that knowledge of this technology has probably lagged behind its application. Valuable work on this subject has been carried out by the Servo Panel of the Ministry of Supply during the War, and although the attention of this Panel has naturally been directed towards the problems of control in military usage, as, for example, those inherent in the use of predictors, there is much ground common to these problems and those connected with the control of industrial processes. It would be a pity if knowledge of the valuable work carried out by the Servo Panel were not made available to those responsible for designing, installing and running control systems in industry. If industry is to make full use of instrumental control, as it undoubtedly must do, then it would appear essential that the establishment of courses in technical institutions in the technology of instrument control should be very seriously considered.

In reviewing the proceedings of the Conference, perhaps the most vivid impression left on the mind is the general agreement which exists that the training of physicists is not complete unless it results in students obtaining some knowledge of the more general applications of physics in industry and, in particular, of the use of physical principles in the control of industrial processes. It was urged at the Conference, as indeed it has been urged elsewhere, that the equipment of the ordinary university physics laboratory might well include examples of instrument controls, and that in their practical courses students might examine the performance and limitations of these systems.

The Conference will have been well justified if it has emphasized the urgent necessity for a more general and thorough knowledge of applied physics, and if it has demonstrated that the use of instrument controls in industry is based on a technical science of which knowledge at the moment is far too limited.

PLANT PATHOLOGISTS IN GREAT BRITAIN

A REPORT, "The Recruitment and Training of Plant Pathologists in Great Britain", which has been prepared by the Plant Pests and Diseases Committee and adopted by the Council of the Association of Applied Biologists, advocates certain improvements in the training of plant pathologists with a view to a higher and more uniform standard of proficiency at the time of recruitment into the service. The term 'plant pathology' in this report is used in its widest sense to include all disorders of plants, whether caused by insects, fungi, bacteria, viruses, etc.

The plant pathological services in Great Britain have in the main been recruited from graduates of university biological (and to a less extent, chemical) departments who, in the majority of cases, have carried out postgraduate research, usually to the stage of obtaining a Ph.D. degree. This mode of

training is considered to be too narrow, as it does not give proper emphasis to general aspects of crop husbandry, but tends to produce specialists in disease problems who are insufficiently acquainted with the day-to-day problems of the practical cultivator. Recommendations for an improved course of training are put forward in some detail, the most important of which are as follows.

The basic requirement for an entrant into the profession, whether as research worker or as advisory officer, is held to be the possession of a good university degree in pure science (namely, in botany, zoology or chemistry); but this should be reinforced by a post-graduate course of study in plant pathology which might suitably lead to a diploma in this subject. It is suggested that two years would be ample for such a course. The students, whether intending to become research workers or advisors, and whether entomologists or mycologists, would follow the same course for a considerable period, so that all would possess the same general background, and only in the later part would there be specialization in the various lines of activity. In particular, the importance of considering research workers and advisory officers as equivalent groups and therefore of giving them essentially the same training is stressed. Throughout this course there would be instruction in crop husbandry and in research methods, and facilities would be provided for bringing all students in contact with the practical problems of plant cultivation.

The carrying out of this scheme would be most suitably done in an institute of plant pathology, properly staffed for teaching and for the prosecution of applied research; and with good contacts with the industry on one hand, and with a university on the other. Failing the setting up of such an institute, certain university departments should be strengthened along the lines indicated.

The need for refresher courses for advisors and research workers, for greater provision of technical assistance, and for the grant of scholarships to cover the period of two years postgraduate training is also indicated.

Copies of the report can be obtained from the president of the Association of Applied Biologists, Dr. C. B. Williams, Rothamsted Experimental Station, Harpenden, Herts.

HOSPITAL DIET

IN 1943, King Edward's Hospital Fund for London published its first Memorandum on Hospital Diet (*Nature*, **155**, 433; 1945). Since then there has been much constructive criticism. There has been so much demand for the Fund's first memorandum that the Committee on Hospital Diet which it appointed, the chairman of which is Sir Jack Drummond, has now issued a second memorandum (obtainable from G. Barber and Sons, Ltd., 23 Furnival Street, E.C.4, 9*d*.). Everyone who has to cater for groups of people should read it. The housewife, also, will learn much from it.

In many hospitals, says this second memorandum, the importance of good catering is now recognized; but in others it is not. The catering department of a hospital should be regarded as one of the hospital's main departments. It should be a separate unit, administered by a catering officer, who should preferably be a dietitian with adequate experience of large-scale catering. Such dietitians are scarce and more will have to be trained. The catering officer should be responsible for the buying and storage of food, the planning of menus and the cooking and service. This would ensure the unification of the responsibility for catering which is essential. Another essential is direct contact with the food markets and trade, and the memorandum discusses in some detail the buying and storage of foods and the keeping of proper records. The catering officer should be responsible to the governing board through the chief executive officer and through a diet and catering committee; he should co-operate also with the medical staff, who often prescribe special diets as a part of their treatment. The catering officer would thus have considerable responsibility and his office should have appropriate dignity. The diet and catering committee would be technical and professional and would have functions, in its own sphere, similar to those of the medical committee, the ultimate responsibility resting with the board of management.

This committee would not, however, abolish the existing personal relation of the nurse and her patients. Nurses would still serve meals; but the meals would be not only nutritionally sound, but also appetizing and attractive. Such small but important details as the introduction of a little colour into a meal tray by the use of a coloured sauce receive the attention which they deserve. A section of the memorandum is rightly devoted to the diet of the doctors, nurses and others whose work creates for them dietary needs different from those of people who work outside hospitals. The ancillary reforms in the training and efficiency of all grades of kitchen staff also receive adequate consideration.

The committee hopes to see the final abolition of the practice of serving in hospitals only one cooked meal a day, so that relatives and friends of patients would no longer have to bring in supplementary foods. It is odd, however, to find that, among such supplementary foods, eggs and fruit are classed as luxuries. The specimen diets, the seven pages of recipes, the sections on menu-planning and storage of food, the wise advice about salads and raw vegetables, the tables of the nutritive values of various foodstuffs and the valuable section on the destruction of food elements, such as vitamin C, by improper cooking, will interest everyone.

The whole memorandum is so free from the fads and nonsense so often associated with brochures about food that it can be thoroughly recommended.

G. LAPAGE.

FORTHCOMING EVENTS

Saturday, December 15

ASSOCIATION OF SCIENTIFIC WORKERS, LEEDS BRANCH (at the Riley-Smith Hall, University Road, Leeds 2), at 2.30 p.m.—Second Conference on "Science and Education". Prof. J. D. Bernal, F.R.S.: "The Policy of the Association of Scientific Workers in regard to Science and Education".

SOCIETY OF CHEMICAL INDUSTRY (joint meeting of the FOOD GROUP with the YORKSHIRE SECTION of the S.C.I. and the HULL CHEMICAL AND ENGINEERING SOCIETY, in the Lecture Theatre of the Mining Department, The University, Leeds), at 3 p.m.—Mr. J. Pryce Jones: "Honey".

Monday, December 17

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Lecture Theatre, Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Dr. W. G. Thompson: "Electronics, their Scope in Heavy Engineering".

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, South Kensington, London, S.W.7), at 8 p.m.—Wing-Commander D. C. McKinley and Wing-Commander R. Winfield: "The Arctic Flights of the *Aries*".

Tuesday, December 18

SOCIETY OF CHEMICAL INDUSTRY, AGRICULTURE GROUP (in the Chemistry Lecture Theatre, Imperial College, Imperial Institute Road, London, S.W.7), at 2.30 p.m.—"Role of the Chemist in Dairying". Dr. A. L. Provan: "The Chemist and Milk Production"; Mr. E. V. Anderson: "The Chemist in Milk Processing and Manufacture".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Sir Henry Dale, O.M., Pres.R.S.: "Recent Developments in Chemical Therapeutics", (iii) "Penicillin and other Antibiotics".

EUGENICS SOCIETY (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Dr. D. V. Glass: "Aspects of the Development of Population Policy".

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 5.30 p.m.—Mrs. K. M. Trowell: "Modern African Art in East Africa".

BRITISH RHEOLOGISTS' CLUB (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2), at 6 p.m.—Dr. E. Preston: "The Flow of Glass".

Wednesday, December 19

PHYSICAL SOCIETY, COLOUR GROUP (in the small Physics Lecture Theatre, Imperial College, Imperial Institute Road, London, S.W.7), at 3.30 p.m.—Dr. W. S. Stiles: "Colour Discrimination, the Visibility Curve and the Trichromatic Theory".

ROYAL COLLEGE OF SURGEONS OF ENGLAND (at Lincoln's Inn Fields, London, W.C.2), at 5 p.m.—Prof. H. Barcroft: "The Circulation in Human Skeletal Muscle".

SOCIETY FOR VISITING SCIENTISTS (at 5 Old Burlington Street, London, W.1), at 7.30 p.m.—Discussion on "Science in Australia and New Zealand" (Speakers: Mr. G. B. Gresford, Dr. C. H. Kellaway, F.R.S., Dr. I. E. Coop or Dr. J. C. Andrews, and Dr. F. P. Bowden).

Wednesday, December 19—Thursday, December 20

SOCIETY FOR GENERAL MICROBIOLOGY (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1).

Wednesday, December 19

At 10 a.m.—Symposium on "Variation of Cells having Bi-Parental Inheritance" (to be opened by Prof. C. K. Ingold).

At 2.30 p.m.—Symposium on "The Role, Organisation and Maintenance of Collections of Living Micro-organisms" (to be opened by Prof. Johanna Westerdijk).

Thursday, December 20

At 10 a.m.—Miscellaneous Papers.

At 2.30 p.m.—Demonstrations.

Thursday, December 20

ROYAL COLLEGE OF SURGEONS OF ENGLAND (at Lincoln's Inn Fields, London, W.C.2), at 5 p.m.—Prof. O. G. Edholm: "The Circulation in Human Skeletal Muscle".

BRITISH INSTITUTE OF RADIOLOGY (in the Reid-Knox Hall, 32 Welbeck Street, London, W.1), at 8 p.m.—Mr. M. H. Lupe and Mr. L. A. Kemp: "The Physicist in the Radio-Diagnostic Department".

APPOINTMENTS VACANT

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

LECTURER (full-time) IN CHEMISTRY—The Principal, Acton Technical College, High Street, Acton, London, W.3 (December 21).

SENIOR RESEARCH SCIENTIST in connexion with the development of a long-term programme of research on the overseas transport of refrigerated food cargoes, and a CHIEF TECHNICAL ASSISTANT in connexion with research on the overseas transport of refrigerated food cargoes—The Secretary, Refrigerated Cargo Research Council, c/o Australian Tonnage Committee, 88 Leadenhall Street, London, E.C.3 (December 22).

LECTURER IN CHEMISTRY (chiefly Organic) to Honours Degree standard, in the Constantine Technical College—The Director of Education, Education Offices, Middlesbrough (December 22).

TEACHER (full-time) OF ENGINEERING WORKSHOP PRACTICE—The Principal, Aston Technical College, Birmingham (December 22).

SCIENTIFIC OFFICER, and a SENIOR SCIENTIFIC ASSISTANT, in the Department of Agricultural Economics—The Secretary and Registrar, The University, Bristol (December 29).

ASSISTANT ENGINEER for the Iraqi State Railways—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting E.2150.A (December 29).

LECTURER IN CHEMISTRY at the Military College of Science, Stoke-on-Trent—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting F.4645.A (December 31).

DEPUTY CHIEF ENGINEER—The Engineer, River Nene Catchment Board, Engineer's Office, Priestgate, Peterborough, endorsed 'Deputy Engineer' (December 31).

RESEARCH MYCOLOGIST to be attached to the Plant Protective Chemistry Section for investigations on laboratory and greenhouse methods for the bio-assay of fungicides, an ENTOMOLOGIST (resident in Scotland) to assist research into the causes and control of crop failure in the Scottish raspberry growing areas, a RESEARCH ENTOMOLOGIST to be attached to the Plant Protective Chemistry Section for investigations on laboratory and field methods for the bio-assay of insecticides, and a HORTICULTURIST to carry out research at East Malling and in Scotland into the propagation and cultivation of Small Fruits, with particular reference to the raspberry—The Secretary, East Malling Research Station, East Malling, Maidstone, Kent (January 1).

CHAIR OF ZOOLOGY in the University of Cape Town—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting F.5269.A (January 1).

ASSISTANT LECTURER, Grade III, IN THE DEPARTMENT OF METALLURGY—The Registrar, The University, Liverpool (January 1).

CHEMIST IN THE DEPARTMENT OF DAIRY CHEMISTRY—The Secretary, National Institute for Research in Dairying, Shinfield, Reading, Berks. (January 1).

LECTURER IN THE CHEMISTRY AND BIOLOGY DEPARTMENT—The Registrar, Municipal College, Portsmouth (January 5).

LECTURER IN ZOOLOGY in the University of Tasmania—The Agent General for Tasmania, Australia House, Aldwych, London, W.C.2 (in Hobart, January 7).

DIRECTOR OF CHEMICAL LABORATORY—must be F.R.I.C. and possess the Branch E Diploma of the Royal Institute (Ref. No. F.5248.A), and an ANALYTICAL SPECIALIST, with wide experience preferably in analysis of soils, water, cement and other constructional materials, petroleum products, oil seeds and cake, etc. (Ref. No. F.5249.A), to the Iraq Government—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting the appropriate Ref. No. (January 8).

TELECOMMUNICATIONS ENGINEER (Ref. No. D.1606.XA), a CIVIL ENGINEER for appointment as Area Engineer (Ref. No. E.2127.XA), and MECHANICAL ENGINEERS (2) for Shift Work operating Steam-Driven Electrical Power Plant (Ref. No. C.2065.XA), by an Oil Company in the Middle East—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2 (January 10).

ASSISTANT LECTURER AND DEMONSTRATOR IN THE DEPARTMENT OF PHYSICS—The Registrar, University College of South Wales, Cathays Park, Cardiff (January 15).

CHAIR OF ELECTRICAL ENGINEERING—The Secretary of University Court, The University, Glasgow (February 11).

CHAIR OF AGRICULTURE (Animal Husbandry) in Canterbury Agricultural College, Lincoln, New Zealand—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (February 28).

LECTURER (Grade II) IN PETROLOGY AND MINERALOGY—The Secretary and Registrar, The University, Bristol (February 28).

MYCOLOGIST, and a BOTANIST, for the Rubber Research Scheme, Ceylon—The Chairman, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, London, S.W.7 (February 28).

LECTURER IN MEDICAL PARASITOLOGY—The Secretary, Department of Entomology and Parasitology, School of Tropical Medicine, Pembroke Place, Liverpool 3 (March 1).

LECTURER (full-time) IN THE DEPARTMENT OF MENTAL HEALTH—The Secretary, The University, Aberdeen (March 23).

CROMBIE ROSS CHAIR OF MENTAL HEALTH—The Secretary, The University, Aberdeen (March 30).

LECTURER IN BACTERIOLOGY—The Registrar, The University, Sheffield (March 30).

FOURTH LECTURER IN BACTERIOLOGY—The Secretary, The University, Edmund Street, Birmingham 3 (March 31).

PROFESSOR OF PSYCHIATRY, and a PROFESSOR OF MEDICINE—The Registrar, The University, Leeds (March 31).

ASSISTANT BIOCHEMIST (graduate) for Clinical Laboratory—Prof. Dunlop, Clinical Laboratory, Royal Infirmary, Edinburgh.

SKILLED MECHANICS for medical research workshop—The Director, Radiotherapeutic Research Unit, Hammersmith Hospital, London, W.12.

LECTURER IN THE CIVIL AND MECHANICAL ENGINEERING DEPARTMENT (with Structures as one of the main subjects)—The Secretary, Woolwich Polytechnic, Woolwich, London, S.E.18.

LECTURER IN ENGINEERING—The Principal, Leicester College of Technology and Commerce, Leicester.

LECTURER IN MECHANICAL ENGINEERING SUBJECTS to Higher National Certificate standard in the Crewe Technical College—The Director of Education, County Education Offices, City Road, Chester.

SENIOR TEACHER OF MATHEMATICS in the Engineering Department of the Burton-upon-Trent Technical Institute and Junior Technical School—The Secretary and Director of Education, Education Offices, Guild Street, Burton-upon-Trent, endorsed 'T'.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Geological Survey of Great Britain. Wartime Pamphlet No. 7: High-Grade Silica Rocks of the Scottish Highlands and Islands. By Dr. J. G. C. Anderson. Second edition. Pp. 32. 1*s.* 6*d.* Wartime Pamphlet No. 13: Limestones of Scotland, Area 4, South-West Highlands and Islands. By Dr. J. G. C. Anderson, with Analyses by Dr. A. Muir. Second edition. Pp. 26. 1*s.* 3*d.* Wartime Pamphlet No. 43: The Geology of the Northern Part of the South Staffordshire Coalfield (Cannock Chase Region). By Dr. G. H. Mitchell; Palæontology, by Dr. C. J. Stubblefield, with section on Fossil Plants, by Dr. R. Crookall. Pp. 50. 2*s.* 3*d.* (London: Geological Survey and Museum. 1945.) [238

London School of Hygiene and Tropical Medicine. Report of a Meeting of the Ross Institute Industrial Advisory Committee, held in the Council Chamber of the Rubber Growers' Association, 19 Fenchurch Street, London, E.C.3, on Thursday, 12th July, 1945. Pp. 22. (London: London School of Hygiene and Tropical Medicine, 1945.) [298

Ministry of Agriculture and Fisheries. Bulletin No. 130: Threshing of Grass, Root and Vegetable Seed Crops. Pp. 20+3 plates. (London: H.M. Stationery Office, 1945.) 9*d.* net. [298

Printed in Great Britain by Fisher, Knight & Co., Ltd., The Gainsborough Press, St. Albans, and published by Macmillan & Co., Limited, at St Martin's Street, London, W.C.2, and The Macmillan Co., 60 Fifth Avenue, New York 11, N.Y., U.S.A.—Saturday, December 15, 1945.