NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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THE UNIVERSITIES IN WAR-TIME

THE function of the universities in relation to research needs in war-time may not be so well appreciated as other factors which at the present time are directing attention to their place in the national life of Great Britain. Like other educational institutions, their work has in many places been seriously disturbed by the exigencies of evacuation. Both research and teaching have been interrupted, and even where satisfactory and efficient arrangements have been made in the reception areas for the performance of those functions, great difficulties have frequently been met by students. These difficulties, for example, have deprived University College, London, and the London School of Economics of half their students. Although a number of evacuated university institutions are now expected to return to their normal quarters by the autumn term, there is sound reason in the appeal of the National Union of Students for a Government grant to enable students who would otherwise be deprived of their education to continue their studies.

The attempt to return to normal education and to evolve a sound and practical policy out of the muddle into which evacuation has thrown it must include university education along with the elementary and secondary stages. In contrast to 1914, the universities have indeed already been recognized by Government as institutions of national importance, both from the point of view of assisting in the War, and also of maintaining higher learning and culture. The welcome news that the Government has decided to maintain its Treasury grant at the pre-War level (see NATURE, February 24, p. 299), strengthens this conviction. In the contacts of the past year or so between the universities and the Service and other Government departments in regard to the utilization of personnel and facilities, and particularly in the sympathy and understanding which characterize this co-operation, we have evidence that the role of the universities in supplying the educated and trained leadership essential in handling the problems of a democratic society is fully appreciated by the Government.

If therefore it is admitted that universities are vital necessities in the efficient service of the needs of a democratic society, whether as an industrial nation in a world where science is the basis of power, or in the defence of its life, its liberties and traditions against the methods of modern warfare, it can scarcely be disputed that a grave responsibility must rest on the universities in the preservation of the permanent values of our ordinary life. The autonomy of government, the freedom of speech and thought and investigation which are cherished privileges of British universities, place upon them a prime responsibility to provide the informed and disciplined intelligence that alone can be adequate to meet the needs of a post-War world, to repair the breaches made in our institutions by the War, and to reconstruct those parts of our political and economic system which are shown to be defective by the War. If reconstruction is to have a practical meaning, it requires at once the trained and disciplined intelligence, the impartial and patient analysis, the imaginative insight on human issues, the sense of values and creative force which it should be a chief glory of our universities to supply.

The importance of the contribution which the universities can make to the winning of the War, to the planning of the peace and the provision of

leadership of the requisite capacity, makes it essential that the ways and means by which that contribution is made should be rigorously re-examined. It is no simple problem to secure the economy that may justly be demanded, without endangering the deeper values which a university must always safeguard. The Treasury grants to the universities have always recognized the right of the universities to enjoy complete freedom. In war-time, that independence must be preserved at all costs. Nothing is easier than for the essential liberties for which we are contending to be endangered and lost by gradual encroachment under the duress of war.

Unsleeping vigilance in these matters is essential, but the universities must prove themselves worthy of that independence by the thoroughness of their response to the national need, and the ability with which they not only maintain their highest traditions but also raise the efficiency of their service. On the economic side there are things with which they can do without, and without which they will be content. They will not expect the same funds for new buildings which in better times they ought to have. It is not in war-time that we can expect most of our modern universities to approach nearer to the Platonic ideal that youth should be brought up "amid fair sights and sounds".

The essentials of university education must not be stinted. Municipal bodies, like the State, should continue their help at least undiminished, increasing it where those essentials are lackingor inadequately provided. Even in war-time, it is a good investment for the nation to provide at the modern universities more opportunities for healthy recreation as a part of the corporate life. The Physical Education Centre which the University of Manchester has recently opened is a token of the movement to make the life of the modern university more rounded and complete. Behind that movement, moreover, lies the possibility of developing a system of physical education which will make the student's life happier and more efficient in the best sense ; and there is a large field for research, the knowledge garnered from which may be applied not only to university students but also to adolescents generally.

Here is only one of the directions in which the universities might, even in war-time, extend their services to the community. There is also a great task in extra-mural work, which some of them are already shouldering, despite all the handicaps imposed by the black-out. Programmes of lectures are being provided for troops in the areas served by the universities in an attempt to see that the minds of those called to the colours do not stagnate or become set in Service grooves. In spite, too, of the dislocation of civil life and the long hours put in on munitions, the demand for tutorial classes is strong, and the teaching normally done outside the universities on their own initiative or in collaboration with the Workers' Educational Association proceeds vigorously.

The significance of this extra-mural work should not be under-rated. As Dr. W. C. Mitchell reminds us in his presidential address to the American Association for the Advancement of Science (see NATURE of February 10, p. 207) the gravest dangers to democracy come from within, not from without. The universities have a decisive part to play in dispelling ignorance and countering by critical inquiry the propaganda which turns ignorance to its uses. In war as in peace, those who cherish learning must seek to foster, by all means within their power, a scientific attitude among their fellow citizens. Extra-mural work offers an invaluable opportunity of developing respect for evidence and promoting a general understanding of the methods and results of science.

Important as may be the educational functions of the universities in such extra-mural fields, it is to the training given within their walls and to their functions in the advancement of knowledge and the maintenance of standards that attention is at present being most clearly directed. The pursuit of knowledge and the training of youth must indeed go hand in hand with the cherishing of human values—of personality, of freedom and truth—if a university is to make its full contribution to the enrichment of national life, above all by inspiring that deep consciousness and appreciation of the national heritage which alone can sustain the effort and sacrifices which their defence may well demand in the present struggle. Whatever resources may be available for the universities —and the importance of their contribution to our war effort and the preservation of the permanent values of our heritage may well justify expansion rather than contraction of those resources—the present position demands that they should be used as wisely and efficiently as possible.

It is from this point of view that it is imperative to re-examine the utilization of these resources and their distribution over the various functions of a university and the numerous branches of learning

which it serves. Let no one imagine that this is a simple task. The complexity of the relations between the different functions and faculties must not deter us from the task, and the gravity of the danger which threatens all alike may well be sufficient at last to initiate the effort.

In regard to the advancement of learning, the university occupies a place in the research front. If knowledge is to be available to serve the war-time needs of the nation no less than to solve the problems of peace, some means must be found of keeping an appropriate balance between fundamental and applied research, of providing for the following-up of advances in knowledge, and of diverting effort to fields neglected or holding up the general advance. All this must be done without endangering that freedom of investigation and spirit of unprejudiced quest for truth which lie at the root of all scientific advance. Particularly is it important to provide for investigations in the domain of human relations, where lack of knowledge is already handicapping our war effort in many fields.

The advancement of knowledge links itself naturally with the teaching functions of the university through the thorny problem of the relation of teaching and research. Here we may well have to review the whole question of technique in the light of recent criticism and discussion on the use of the lecture or the tutorial system. Similarly, we have to consider the efficiency of research at the universities, not merely in terms of the claims of teaching, tutorial or administrative duties, but also in regard to the provision of adequate assistance or services in the laboratories, so that the best use is made of the time of qualified research workers.

These are questions which, like those of professional training, may well occupy the attention of the universities themselves and also of the many professional associations of scientific workers and their fellows. We cannot expect in the stress and strain of war to find and apply a completely satisfactory solution to them all. We may indeed need to be content with eliminating major causes of inefficiency and securing a modicum of co-operation in the pursuit of knowledge where it is most required. If, however, scientific and professional workers, whether within the walls of a university or without, are zealous enough in cherishing a high ideal of the functions of a university and give their minds, even in war-time, to such problems as these, then at least we may be sure that the universities of Great Britain will carry undimmed through these dark days their power to inspire, and to provide the loyal and unselfish leaders the nation needs both now and in the days of reconstruction to come.

CANCER: THE ROLE OF SURGERY, RADIUM AND X-RAYS IN ITS TREATMENT

THE treatment of cancer has occupied an increasingly important position in public thought during the last few years. The debate in Parliament on the Cancer Bill laid bare the scanty provisions for adequate treatment existing in many parts of Britain. The war crisis in September which temporarily curtailed medical facilities resulted in an insistent demand for the treatment of cancer, a demand not immediately heard for the treatment of most other diseases. One aspect of this interest is the difference of opinion as to the proper scope of radium treatment relative to other methods, a difference illustrated by recent and present correspondence in NATURE (**144**, 973; 1939; **145**, 151; 1940; also p. 347 of this issue).

Before attempting an assessment of the present status of cancer treatment, it will be instructive to examine first the extent to which cancer is in fact being treated in Great Britain at the present time, and the means available. A recent Ministry of Health inquiry* showed that in a representative sample 27 per cent of all cases were actually treated by either surgery or radiation, including purely palliative treatment. Allowing for possible groups of cases not coming into the sample, it is safe to say that less than 30 per cent of all cases occurring receive treatment. As to the means available, there are only two by which successful cure of cancer can be achieved—surgical excision and radium or X-ray therapy.

*"Cancer: An Enquiry into the Extent to which Patients receive Treatment." Reports on Public Health and Medical Subjects, No. 89 (H.M. Stationery Office.)

Surgery was first in the field, and indeed was for many years the only available method of treatment. The principle underlying its use is simplicity itself; extensive removal of the growth along with the whole of the affected part. The effective use of surgery in cancer dates back to about half a century ago. At that time surgical techniques were evolved which are still known by the names of their creators—Halstead, Kocher, Wertheim, and many more. The surgery of cancer is now relatively stable; its accomplishments are known, its limitations accepted.

In contrast to surgery, radium and X-ray therapy are still young and developing branches of medical science. Although radium was discovered in 1898 and was applied to minor medical use shortly afterwards, it did not become an important means of treating cancer until after the War of 1914–18. In the decade 1920–1930 the significance of the work which was being done in three now famous radiation therapy centres—the Fondation Curie in Paris, the Radiumhemmet in Stockholm, and the Memorial Hospital in New York—was gradually realized. It was not, however, until about the end of that decade that the impact of these revolutionary methods became generally felt. In Great Britain one result was the establishment of the Radium Trust and the creation of the National Radium Commission Centres for the provision of efficient radium treatment. It is then no overstatement to say that this new medical specialty is a mere ten years old, and still in an evolutionary phase. This fact has three consequences. In the first place, it is only over a very limited field of use that methods of treatment are as yet sufficiently standardized to represent an established practice of modern medicine. In the second place, it is vital that its value be judged in terms of its capacity as known to-day, and not in terms of its accomplishments of even a brief five years ago. Thirdly, it holds considerable promise for the future.

To arrive at an objective analysis of the relative value of surgery and radiation it is worth while first to examine the nature of the 27 per cent of treated cases mentioned above. The striking fact which emerges from such a study is that treatment is limited to a comparatively small number of cancer types. Of the 27 per cent of all cases occurring which in fact received treatment, no less than three-quarters belonged to one or other of the following five cancer groups: cancers of the stomach, intestine and rectum; cancer of the breast; cancer of the skin, including genitalia; cancers of the mouth, tongue and lip; cancers of the uterus and vagina.

Cancer of the stomach, intestine and rectum constitutes almost exactly 400 out of every 1,000 cancer deaths and represents one of the very commonest types of cancer found. In view of this, it is depressing to find that only 8 per cent of this group are seen sufficiently early to permit an attempt at cure. The treatment is almost exclusively surgical and radiation is as yet of little value. A generous estimate of the percentage cured would be 15 per cent of cases treated.

Cancer of the breast constitutes 200 cases per 1,000 of all cancer deaths occurring in women. It was found to have been treated in 68 per cent of cases. Breast cancer undoubtedly represents the field in which surgery has accomplished its greatest victories. It is still the treatment of choice except in those cases which are inoperable when first seen. In these, radiation does provide a useful alternative method. In many cases both surgery and X-ray therapy are combined with great advantage. A fair estimate of the surgical cure-rate is 25–30 per cent of all cases operated on. In the really early cases a cure rate of up to 75 per cent can be obtained. Cancer of the breast should be looked upon, therefore, as a mainly surgical field.

Carcinoma of the skin represents only a small proportion of all the cases occurring. It can be treated by wide surgical excision, or it can be treated by radiation—either radium or X-rays—with equal or even greater certainty of cure and without the same degree of disfigurement; indeed, often such a return to normal occurs that the site from which the disease was eradicated cannot be distinguished. An estimate of the cure-rate of true skin cancer (squamous cell carcinoma), adequately treated by either method, may be given as about 75 per cent. The less serious form of skin cancer, known as rodent ulcer, if treated properly rarely proves fatal. This field is therefore one which can be equally called surgical or radiological, but the cosmetic advantage lies with radiotherapy.

Cancer of the mouth constitutes just under 100 cases per 1,000 of all cases occurring in men, and analysis showed that 71 per cent were treated. There is little doubt now that radiation, particularly radium, has become the treatment of choice in this disease. The majority of mouth cancers occur in parts where surgery is not practicable. Where excision is possible, for example, in some carcinomas of the tongue, surgical cure is

infrequent and is attended with marked disability. Extension of the disease from the mouth to the glands in the neck may, however, be dealt with either surgically or radiologically. Many cases of mouth cancer come for treatment when the disease is already advanced, yet even so cure-rates of 25–30 per cent for all the cases treated have been reported by British radiation therapy centres. For the early case, the chance of cure is at least 50 per cent. The mainstay of treatment of mouth cancer must therefore be accepted as being radium therapy.

Cancer of the uterus (uterine cervix) represents 133 cases per 1,000 deaths from cancer in women. Before the days of radiation it was treated surgically. This has now been abandoned in all modern schools. The present situation has been described in a recent survey where it is stated that "radiation offers a prognosis some 10 per cent better plus an appreciable salvage of inoperable cases. . . . To-day the prognosis from good radiation therapy is a one in two chance of cure in an operable case, and a one in seven chance in an inoperable case, and in selected centres the prognosis is even better, the chances being two in three and one in four respectively". The rapid transition from surgical to radiation treatment is largely due to the statistical findings of the Health Section of the League of Nations. This disease can therefore be listed as an exclusively radiation field.

These five diseases together account for 75 per cent of the treated cases. The remainder include cancers of the lung, œsophagus, bladder, ovary, larynx and a large variety of less common lesions. Talking in general terms, treatment by surgery and by radiation is probably about equally common, and radiation is showing curative possibilities in a number of lesions which are impossible of surgical approach.

We see, therefore, that in three out of the five main curable types of cancer considered, radiation now occupies a place so generally accepted that patients treated otherwise cannot be considered as receiving the maximum chance of cure.

The value of radium and X-ray therapy is, however, not limited to the treatment of forms of cancer in which permanent cure is possible. It can serve two other quite important functions. In a wide group of malignant growths, which include the lympho-sarcomata, radiation can control the disease and maintain the patient in a fair state of health for long periods. Another way in which radiation is extensively used is to obtain palliation of advanced cancers where cure is impossible. These cancers include the late stages of all those types which are curable in the early stages by radiation or surgery and many more. The growth of the tumour can be arrested temporarily, with disappearance of the attendant pain and disability. Even although life is only prolonged for a short time the reduction in suffering is great. Surgery has contributed two useful measures to the palliation of cancer—gastrostomy and colostomy. Both these measures, by affording mechanical relief in incurable cases, prolong life and reduce suffering.

Much has been written on the dangers of radiation treatment, as in the past of the dangers of surgical treatment. Where the disease concerned is cancer, in which the mortality of untreated cases is 100 per cent, danger should obviously not be overstressed. In surgical techniques a certain 'operative mortality' is regarded as inevitable. In the use of radiation for the cure of cancer similar 'treatment risk' must be faced. In both surgery and radiotherapy this risk varies in direct ratio to the magnitude of the undertaking and in inverse ratio to the skill of the operator or therapist. While the immediate risk of death is lower with radiation treatment, a new risk has to be taken, namely, that of local necrosis due to the treatment. At times this is unavoidable, and necroses may be faced at the time of treatment as being the price of what is regarded as curative treatment. Such necroses can be repaired later by plastic surgery.

The nature of the action of radiation on malignant tissue is a totally different process from that of excision, and radiation should not be thought of as a refined form of cautery. While surgery seeks the eradication of the disease by wide excision, radiation has a selective action on malignant cells in those groups of cases where the radiotherapist claims success. In the epitheliomata and the sensitive sarcomata it is possible to give a dose of radiation which will destroy the malignant cells while doing only temporary harm to the surrounding normal tissues. The margin between lethal dosage to the malignant cell and the lethal dose of the normal tissue is, however, quite a narrow one. To permit the successful use of this differential sensitivity an expert training in radiotherapy is necessary, both to assess a suitable dosage and to choose the best means of delivering that dosage accurately to the tumour with a minimal radiation of healthy tissue.

Radiation has occasionally been stated to

produce metastases and to 'stimulate' the growth of malignant cells. Neither of these statements can be substantiated.

In the development of radiotherapy a vast amount of experimental work is still necessary. At present the techniques employed are based on clinical experience, which is necessarily conservative. The choice, for example, of radium versus X-rays depends on the mechanical applicability of either to any particular lesion rather than on any known advantage of wave-length. In accessible sites it is usual to choose radium, which remains the more valuable of the two methods. X-rays are used in the radiation of deep-seated lesions and in widening the zone of tissue treated from a radium source.

Another factor which requires investigation is the optimum overall time of radiation. At present the times used depend on clinical experience, and it is felt that other overall times or time splittings of dosage may be found in the experimental field which will alter considerably our methods of treatment.

While stressing the need for developmental work in radiation methods and the value of surgery and radiation in their respective fields, it is necessary to state that the greatest increase in the cure-rate in these fields would be obtained by a successful campaign to get patients in the early stage of their disease. A well-planned scheme of public education and clinics as envisaged in the Cancer Bill would facilitate this.

RUTHERFORD

Rutherford
Being the Life and Letters of the Rt. Hon. Lord Rutherford, O.M. By Dr. A. S. Eve. Pp. xvi+451+18 plates. (Cambridge: At the University Press, 1939.) 21*s.* net.

PROF. EVE'S account of the life of his old friend Lord Rutherford treats it in the perfectly straightforward manner which such a book should. He takes the reader steadily through the life from boyhood in New Zealand to the 1851 Exhibition at Cambridge, the chair at Montreal, the chair at Manchester, and the return to Cambridge. A great part of the history is given through the medium of Rutherford's letters, many of the earlier ones being those written to his future wife.

The order of presentation is rather strictly chronological, so that successive paragraphs may deal with entirely different subjects; for example, they may consist in accounts of a public lecture, a holiday journey, the organization of a department, and a new scientific discovery. In describing the purely scientific work, Prof. Eve at intervals devotes a few pages to a non-technical explanation of its import, which should help the inexpert reader in understanding the steady progress of the discoveries in which Rutherford took the leading part. In fact the biography is cast mainly in the form of a chronicle, and this is exactly the form it should have. There will remain for some later historian, who will have gained the perspective and impartiality of time, the task of assessing the respective merits of the enormous contributions that Rutherford made to physics. Taken in conjunction with his published books and papers, the present biography will provide very complete documentation for such a historian, and it should go a long way towards protecting Rutherford from the two dangers to which the lives of the great seem to be specially exposed, on one side the degeneration into a dreary hagiography, and on the other the psychological account of the (usually Freudian) thoughts which the biographer thinks that his subject ought to have been thinking.

With a biography, as with a portrait, the author is always faced with an almost insuperable difficulty, that of satisfying both those who knew the subject and those who did not. The first expect to be reminded at every turn of the living original, whereas the others, with no personal memories, have to build the whole image out of the author's own work. So it is natural to ask whether Prof. Eve has 'got it across'. He has certainly given himself the best chance of doing so by his copious quotations from the letters. These, be it said, are mostly quite ordinary letters, dealing with the happenings of Rutherford's life, such as those written to his family when on a visit to America, or those to friends on the Continent renewing relations after the War of 1914–18. They are good straightforward descriptions of events, not embellished into anything like belles-lettres—had they been so one would have doubted their authorship—and anyone can feel that he could almost have written them himself. But not quite, for there is a tremendous common sense about them and a vigour raised to high power, which is the characteristic that his intimates will most

remember. But in reading them the intimates will have in mind the associated memories of the general raciness of his conversation, of his amusing reminiscences and the critical but usually kindly comments on his contemporaries. This side of him is very much harder to describe in a biography, because it can only be done by illustrations of a topical kind, and the mere attempt to give them would destroy the lightness which is their essence. It is a matter for briefer treatment than is possible in a book, and we may hope that, before memories fade, there will be gathered together a Rutherford saga, of the kind of which a beginning was made by Tizard's lecture last spring. There are many men, great to their friends but little known to the world, of whom the same sort of thing is true, and usually their memory does not long survive. But here the greatness was combined with an external greatness patent to the world at large. May we not hope that this will just make the difference and lead to the survival of the whole man.

It is impossible to read the life without trying to estimate what the verdict of the distant future will be of Rutherford's various discoveries. Many of them, which in another man would be counted as of the very first class, can be attributed to accurate timing on his part. Rutherford himself used to say, in connexion with some of the wilder speculations of his contemporaries, that no one could see more than an eighth of an inch beyond his nose, and that only a great man could do even that. He had himself just that extra little range of sight beyond the eighth that got him there ahead of the rest. One cannot doubt, for example, that the law of radioactive decay would have been explained by someone else, if Rutherford had not done it a few months earlier. In other cases he got the lead by his capacity for choosing the right one among several confusing alternatives, by his gift for always "picking the right bottle off the shelf". Thus one distinguished man of science would write to him reporting a new type of radiation, and he would be entirely unmoved, correctly attributing the result to some unconsidered impurity, while another would write a very similar letter and he would stop all the other work of the laboratory and Chadwick would discover the neutron.

In the case of some of his discoveries, however, Rutherford was much more than a few months ahead of his competitors. For example, the study of α-particle scattering was undertaken in order to probe into the atom, and the ordinary scattering by electrons did serve to give at least a strong suggestion that the number of electrons was about half the atomic weight; the scattering of a few particles through broad angles was an unforeseen extra gift. It is one of those profitless but interesting speculations to conjecture what would have happened if Geiger had failed to detect those particles, or if, as it would have been almost natural to do, he had explained them away. The nucleus would have had to wait; but for how long? Atomic number would have been discovered, but it would have been through Moseley's spectra and it would have been only a curious numerical rule unsupported by any theory. Would Bohr have made his theory of the hydrogen spectrum, without the guiding principle that there was a centre of force attracting according to the inverse square? Probably, but it might have been somewhat later, and the theory, suspect to the orthodox even as it was, would have had a much more difficult passage. After that there would still have been the experiments on collision to repeat, and so it seems likely that Rutherford found the nucleus at least three or four years before anyone else would have done it.

In the discovery of atomic disintegration he was probably even farther ahead of his contemporaries, and he owed this largely to his breadth in insisting on developing technical methods and exploring whole fields, where smaller men are content to solve single problems one at a time. This wisdom went much farther still, for at an age when most men are entirely set in their habits, he showed that he could recognize that his old simple methods were becoming inadequate for the new knowledge, and that he must—and that he could—embark on the elaborate engineering feats of the modern physical laboratory.

The discoveries of the present epoch can be divided into two types, for which a very good discrimination is according to whether Rutherford liked them or not; the difference can be felt, but it is hard to put it into words in any other way. The nucleus and disintegration were his own, and he foretold the neutron and was in at its birth. He liked Bohr's theory of atomic structure, and accepted the new quantum theory though without much enthusiasm; perhaps this was because for a time it put the theorists above the experimenters. At any rate, he could welcome Gamow's theory of radioactive change, and Mott's work on the interference of α-particles with helium atoms. But the positron was not to his taste; of course he accepted it, but the very abstract idea of 'holes' did not fit his habit of thought. Would he have liked the meson? Probably not. But the most recent discovery of all, the fission of uranium into comparable parts, that would surely have been a discovery which, had he been spared for little more than a year longer, would have been one of the most acceptable to his genius.

C. G. DARWIN.

ELECTRIC CLOCKS

Electrical Timekeeping

By F. Hope-Jones. Pp. xx + 275 + 6 plates. (London: N. A. G. Press, Ltd., 1940.) 10*s*. net.

SOME few years ago, Mr. Hope-Jones brought out his well-known book "Electric Clocks", and I had the privilege which I much enjoyed of writing a notice of it, which appeared in NATURE of October 17, 1931. I am very glad to be enabled again to notice a new book—"Electric Timekeeping"—by the same author. I say a new book because the title is a little different. I think it should be called a new and enlarged edition. "Electric Clocks" came out when it had become generally recognized that the Shortt clock had revolutionized our ideas as to the possible attainable accuracy of pendulum clocks, and when for the first time the uncertainty had been brought down to a matter of a second in a year. There was then full justification for the author, who had himself invented many of the features on which success depended, adopting the role of the high priest and laying down the law as to what is good and what is bad. As anyone who has seen the first would expect, the present work does not falter in this respect.

The author, who has devoted himself to the subject of accurate clock construction for nearly half a century, is so saturated with the subject, and is so familiar with the almost innumerable ways in which the electric current has been harnessed as an aid, that his presentation of the history of the development is almost bewildering in its thoroughness, but there is this which makes his treatment of real value. It is not a mere catalogue of a thousand-and-one devices in chronological order, but a very critical discussion of each showing the valuable original steps which, however, lacked something necessary for real success, or the essential faults in principle which were so common.

In the earlier volume the author led up to what might well be called the perfect clock—or very nearly perfect clock—the Shortt clock. In the present volume the history is mainly a repetition, but much has happened since "Electric Clocks" appeared. The quartz crystal clock, though it had proved its value so long ago as the year 1928, had not then become so well known as it is now, or perhaps had not reached the present high level of performance, which is, I believe, an uncertainty in the rate of one second in two or three years. In 1928, comparisons of Mr. Marrison's quartz clock in New York connected by land line with Mr. Loomis's three Shortt clocks at Tuxedo demonstrated the disturbance of gravity by the moon. Then again the time laid on by the alternating current network in the country, though known as a possible source of accurate time, had not become general as it now is; and in this, by the way, the author appears to have been the first to point out the possibility*. Again, time at sea, which used to be altered daily by the captain when he said "make it so", is now beginning to pass at a variable rate made to fit the easting or westing of a ship on a plan also proposed by the author. These, the Post Office "Tim", and many other things are discussed in the additional matter.

The author may well be pleased to have had the support of the late and of the present Astronomer Royal. These two great authorities have written the forewords to the two volumes, and this is a distinction of which he may well be proud. He is also able to exhibit a frontispiece which itself is an attraction. When crossing the Atlantic to attend a meeting of the Franklin Institute, where he was presented with the much-prized Gold Medal for his share in the development of the Shortt clock, by rare good fortune Einstein was on board. The frontispiece is a 'snap' of the two in earnest conversation autographed by Einstein himself.

It is now nearly fifty years since the author developed that admirable production the synchronome clock, which was a well-deserved success. Relying on the principles which he never tires of preaching, he invented element by element that invaluable instrument. I must mention in particular two of these. The first is the step-by-step dial ratchet which never fails. This is figured on p. 103. It may seem a small thing, but it represents a degree of perfection unknown before. It has the great merit of not being upset even if the ratchet wheel is eccentric or badly divided. The other is the synchronome switch which applies a gravity impulse to the pendulum every thirty seconds. This contains an element of the first importance, a contact which is a really forcible one, that itself transmits the power to lift the gravity arm and thereby lasts only so long as is necessary. This saves battery waste, provides a sharp time signal, and it never fails.

The triumph of the Shortt clock, which after all is based on the synchronome clock, has not caused the author to rest on his laurels. The latter part of the book records one after another of his further inventions. One is a method of synchronizing a light half-second's pendulum depending solely on

* "Lightning", November 15, 1895.

circular error. This is a beautiful device, and if the synchronizing current is first set for every second it very soon starts from rest and is in proper phase.

Another and much less expected invention, if indeed any invention by the author relating to clocks can be considered unexpected, is an alternate current motor of great ingenuity and value. Two microscopic motors of a few mouse-power had hitherto almost monopolized the field. One was the high-speed self-starter, the Warren motor, which can only go one way, and the other the toothed disk lower speed motor, which is not self-starting and which will go either way. Some few weeks ago a public clock was seen to be going backwards and this led to a crowd wondering, I suppose, how long it would be before it would become yesterday again. This might have been due to the man who started it turning the twiddle nob the wrong way. But the author again comes in with an extra slow-speed toothed wheel motor turning once a second with a permanent magnet for the stator. This, he says, is more efficient than the others, which it may well be. I have used the others in other apparatus and determined the mouse-power of each, which was surprisingly large. I should much like to have one of these new motors on which to experiment.

These are only a few of the author's later achievements. They are all so neat and so practical that it is with regret that I am compelled by consideration of space alone to leave them unmentioned.

The book is so well written that in spite of the host of alternative devices described, anyone with a taste for nice mechanics will read it through with avidity and then read parts of it again.

C. V. BOYS.

PAPER

Paper and its Uses

A Treatise for Printers, Stationers and Others. By Edward A. Dawe. Vol. 1. Fourth edition revised. Pp. xiv+188+28 plates. Vol. 2: Samples of Papers and Boards. Pp. vii+157 samples. (London: The Technical Press, Ltd., 1939.) 2 vols., 15*s*. net.

TWO factors combine to make the task of reviewing these volumes an easy one. In the first place they represent the fourth edition of a work which may now fitly be regarded as a classic of the paper and allied industries; secondly, until recently the author directed the activities of the laboratories of H.M. Stationery Office. Both of these considerations are in evidence in the contents of the book. The treatment of the subject combines, in fact, that authority which is born of many years of experience, and that absence of errors and minor defects which is so seldom attained before a work has passed through its early editions.

As the author states in his preface to this edition, the fundamental processes of paper-making have not altered in the relatively short period covered by the earlier editions of the book. Nevertheless, a combination of scientific skill and improved craftsmanship has resulted in many advances, both as regards the quality of the product and the rate of output. Such developments are the principal new features of this edition, the up-to-date nature of which is indicated by the fact that it includes subjects such as the purification of pulp by centrifugal methods; the manufacture of 'two-wire' and artificially conditioned papers (which have contributed so prominently to the solution of the problems of high-speed printing); the coating of papers on high-speed paper machines; air-mail papers; and standards of permanence and the factors which affect this important property of paper.

The first section of vol. 1 is a brief but clear description of paper manufacture, and it follows the usual lines. It is, however, the two subsequent sections, which deal with the different kinds of paper and paper-products and their uses, which single out this work from the many others on papermaking. Into the space of some sixty small pages is compressed a wealth of detail based on sound practical experience. Nothing of importance seems to have been overlooked, and few of the multitude of varied products which originate as paper are omitted. The final sections deal chiefly with testing methods and standardization (matters with which the author has been specially associated), paper trade customs, and methods for the interconversion of sizes and weights of papers. Here again the author steers his way deftly through the maze of intricacies and traditional nomenclature with which the paper industry is still encumbered, and which his own efforts towards standardization have done so much to help to remove.

In the second volume are bound up 157 samples of typical papers and boards, together with the appropriate descriptive details. This volume is

dated 1929, and it seems rather a pity that the opportunity was not taken to bring it up to date also. In some instances (notably the sensitized cheque paper, foil papers and offset papers) the samples included would not find favour among users as typical of the best of their kind. This comment, however, applies only to a relatively small proportion of the samples, and the value of the volume as a whole (especially to the student, for whom it is primarily intended) cannot be over-estimated.

Since the author has now retired from his official position, this work may be regarded as a parting gift to the industry. It certainly deserves to command an appreciative welcome from an industry already so much in his debt for the years of unstinted and able service he has devoted to it.

JULIUS GRANT.

ECONOMY OF A PRIMITIVE PEOPLE

Primitive Polynesian Economy
By Raymond Firth. Pp. xii+387+8 plates. (London: George Routledge and Sons, Ltd., 1939.) 15*s*. net.

THE material upon which Prof. Firth has based his study of primitive Polynesian economy in this book was gathered in the course of his expedition in 1929 to Tikopia, one of the islands of the British Solomons group in the Pacific. A valuable study of the social anthropology of the inhabitants of the island already stands to his credit in a substantial volume. He now turns to an investigation from another point of view—a point of view which is claimed, and justly claimed, to be new, namely, that of the system of values which determines preferences in the satisfaction of needs.

The people of Tikopia, it will be remembered by those who are acquainted with Prof. Firth's earlier book, are virtually untouched by White civilization; and in their mode of life they may be regarded as an example of a people of simple backward culture. When, however, this culture is submitted to examination, it is seen that what may be termed their economy, as thus defined, is by no means simple, but on the contrary is of a highly complex character. It is made no easier of understanding in the eyes of a Western observer by the absence of price and its common measure, money. This absence is, of course, a fact which has not passed unobserved by previous observers of life in other primitive or backward communities; and the differences in standards of value and media of exchange have been the subject of instructive study. Prof. Firth, however, is the first to examine the problem to which it gives rise from the point of view of the functional anthropologist, prefacing his study with a consideration of the general question.

Now it must be clear that the study of the economy of a primitive people may be approached from two very different points of view. On one hand the sociologist, and the observer whose record is intended to meet the needs of a Western audience, will make use of a classificatory system and a terminology based upon concepts which in theory, at least, are abstract and of universal application. The anthropologist, on the other hand, in so far as he aims at an accurate and objective ethnographical record, is concerned with a standard of values that is relative—relative to the culture of the people under investigation. It will be remembered that Prof. Malinowski records a striking example in his account of the system of ritual exchange in the Trobriands in his "Argonats of the Western Pacific", while further examples to which reference has been made are afforded by the refusal of the peoples of Africa to commercialize their cattle, or their reluctance to abandon the use of the hoe for more efficient means of cultivation. It is, however, neglect of this principle of the relativity of any given system of values which has vitiated or caused the neglect of the study of primitive economy.

Applying this principle to the people of Tikopia, Prof. Firth shows how in the instance of food, for example, the bare biological need is transcended by values of a non-nutritional order, as a means of meeting social obligations, the responsibilities of kinship, and other ritual requirements; or again in fishing, it is not the remunerative value of the catch which will determine the direction of effort, but ritual which demands that the first catch should be a shark, rather than the less difficult and more profitable flying-fish. Thus the general trend of this investigation may be summarized as showing that the system of values which it might be argued applies to 'economic man' becomes a matter of social relations, and must be considered in the light of that fact, requiring in the study of primitive economics a profound modification in the usual line of approach.

Prof. Firth has produced a most valuable and stimulating study, which will repay careful consideration, not only by the anthropologist, but also by the administrator and others who have to come into intimate touch with any people of backward culture.

CAN CHRISTIANITY SURVIVE?

The Gospel and the Church

A Study of Distortion and its Remedy. By the Rev. Canon Charles E. Raven. Pp. 256. (London: Hodder and Stoughton, Ltd., 1939.) 8*s*. 6*d*. net.

CANON RAVEN examines the character of Christianity in Apostolic days and also in the early centuries, and shows the serious nature of the distortions that occurred. These are more obvious in the formative period between the second century and the collapse of the Western Empire. There were three directions especially in which the primitive Gospel was abandoned: The renunciation of Nature, the distortion of history and the development of institutionalism. Dealing with the first of these he points to the stress laid on miracles, the craze for which had permeated all classes of society, and as a consequence of this obsession religion was identified with the crudest supernaturalism. The pernicious influence of Jerome in dealing with sex is well known and is shown by his deliberate mistranslation of "almāh" as meaning "virgin" instead of "a young woman of marriageable age", and in many other ways as well. He maintained that both Joseph and Mary preserved their virginity and explained the "brethren" of Jesus by asserting that they were His cousins, children of Clopas or Alphæus and another Mary, sister to the mother of Jesus.

In history the distortion is seen in the almost complete neglect of the Gospel records. With the disappearance of the earthly life of Jesus there arose a multitude of saints, some purely mythical, and through neglect of history religion was largely divorced from life. The loss of the sense of the value of Nature and history implied a change in the quality of Christianity, so much so that during the fourth century "it is doubtful whether we ought to say that the Church conquered the world or that the world invaded and subdued the Church".

In order to explain the persistence of the Church's distortion in regard to Nature and history—and we cannot deny that this distortion is still evident—it is necessary to take into account another condition of its early period, the fixing and form of its organized structure. Owing to the rapid crystallizing of Christian institutions and to the form that they adopted, transitory stages of belief became part of the Church tradition. This subject is dealt with by Canon Raven with consummate skill in Chapter v, "The Church Organic and Organized", and he has no hesitation in attributing the lowering of the spiritual standards in the Christian institutions of the third century to the assimilation of Mithraism. The degradation of the Eucharist is described as one of the most tragic of all the distortions of the Apostolic gospel, but many will wonder whether the description given of the superstitions associated with the Eucharist in the third century is not applicable, in part at least, to large sections of Christendom to-day. If Christian orthodoxy refuses to accept the value of Nature and history—a value inherent in its own basic tenets—can it continue to survive in the environment of modern knowledge?

Two chapters, "The Recovery of Nature" and "The Necessity of History" are constructive; but readers will ask how far it is possible to apply in practice all that is advocated. We are told that if we are to learn the lessons that Nature can teach, "it must be by recovering the sense of its wholeness and its value, the humility and the wonder which science in its conflict with religion too largely lost". Furthermore, it appears that the population outside the churches which has discovered the absorbing interest of Nature can be approached by the churches if they free themselves from a distorted tradition. We are disposed to think that Canon Raven has over-estimated the number of people with the "absorbing interest in Nature". In addition, the form of Christianity that would result from his suggestions would be too emaciated for the great majority of people (we are, of course, considering the adherents of Christian tenets outside Anglicans and Protestant Nonconformists), and many would find refuge in magic, charm, talismans, etc., rather than in a religion largely devoid of the element of mystery. It is certain that Mediterranean Christianity would never assimilate a religion similar to that of the Apostolic days. Again, if we recover a sense of the importance of history, is it possible to believe, remembering the reaction against liberalism from which so much was expected, that a synthetic theology will ensue out of the antithesis of recent years and restore to us the proportion of the faith? Throughout his constructive scheme Canon Raven, in the opinion of the present reviewer, appears to have largely overlooked the strong appeal still made by the pagan elements surviving in Christianity.

The book can be recommended because it contains so much with which all reasonable Christians can agree.

M. DAVIDSON.

WAR AND RECONSTRUCTION*

By Dr. Julian S. Huxley, F.R.S.

EVERYONE realizes, though with very different degrees of awareness and to the accompaniment of feelings that range from ardent hope to sullen resistance, that this War is bound to be followed by radical changes in the structure of separate societies and the organization of the world. In this connexion, biological analogy is helpful not only in creating a general background against which to envisage the coming change, but sometimes in suggesting detailed points in the new order.

In the first place, biology reminds us that change is the normal (though not the universal) rule of life, that certain aspects of biological change can legitimately be called progress, and that man is biologically speaking a very recent type, whose social organization is still primitive in the extreme when looked at in the light of evolution. The lesson of biology for the resistant conservative is therefore that his resistance to change in general is not only useless but also immoral.

But biology has also a warning for the over-enthusiastic progressive. Biological change has normally (though probably not universally) been a very gradual process. The rate varies considerably as between different lines of descent, and at different periods of the world's history, but the change is normally effected through step-by-step alterations of existing organization. In general, it is as frequent for old organs to be converted to new uses as for wholly new organs to be evolved. The zeal of the revolutionary for getting rid of the old system root and branch is thus likely to be wastefully destructive and in the long run to delay progress.

From the point of view of human biology, what are the chief features of the present time which have altered man's social environment so much that corresponding alterations of social organization are needed to meet them—and which, incidentally, have helped to bring about the War ?

The first is the increase in the efficiency and speed of transport and communications, accompanied by the virtual abolishing of frontier space for expansion. This is forcing the remotest regions of the world into often unwilling interaction. It on the one hand provides a potential basis on which world unity could be built, and on the other makes the lack of that unity more and more disadvantageous.

The second is the increase in the potential of power available to States. This is most dramatically seen in respect of war. Armaments have become many times more efficient during the last twenty years. The result is that war has grown out of scale with its function. During many centuries it operated, wastefully enough, yet with a certain efficiency, in adjusting the variations in the balance of power caused by geographical discovery, economic change, and population pressure. But to-day, both its destructiveness and its expensiveness have got out of hand, and have become wholly incommensurate with any positive results which its agency may help to accrue. This, however, is not the only way in which State power has shot up. The dictator regimes have taken into their own hands the organization of economic power and also of the power of opinion. They are in literal truth totalitarian.

The biological analogy shows that for competing nation-States merely to respond to this challenge by corresponding permanent changes in their own organization (however necessary such changes may be as a temporary measure) would be to court disaster. Size and armament alone lead up a cul-de-sac. The giant reptiles of the Mesozoic included the largest carnivores the world has ever seen, like the Tyrannosaurs, and the most heavily armoured animals, like the Stegosaurs and the Ceratopsians. They answered bulk with bulk, aggressive with defensive warfare. But they were all doomed to extinction as soon as the changing environment gave the insignificant but brainier little mammals their chance. The contraction of the world due to better communications provides the corresponding change of environment to-day ; brain-power spent on devising new systems is inevitably destined to supplant the present armoured monsters of the nation-State era. The only question is whether it shall be now, or after more waste and destruction.

A third fact of the utmost importance in the modern world is the search for a new mystic, a new super-personal driving force. Traditional religion of the supernatural type has lost both ground and grip : the curious materialist-idealist compound which expressed itself in the nineteenth century's belief in the inevitability of progress, in the power of knowledge to mould human nature and produce almost millennial prosperity and peace, has wilted in disillusion. In their place, three great nations have already erected new

* Substance of the British and American Association Lecture delivered before the American Association for the Advancement of Science at Columbus, Ohio, on December 30.

pseudo-religions, all of them involving the glorification of the State. The most radical is that of Nazi Germany, which uses the race-concept as its mystical basis, while for Italy the mystic is the nation, and for Russia the millennial picture of the truly Communist society, when Government will wither away.

In all these cases, however, the mystical driving concept is linked with the national organization of power: and this inevitability has brought a recrudescence of intolerance, persecution, and cruelty which has contributed largely to the final shattering of the belief in progress in other nations. History teaches us, however, that intolerant persecution always arises when an unintelligent mystic doctrine is held with such intensity that the end is deemed to justify the means; and that the persecution will be violent and brutal when the mystic doctrine is bound up with the system of power.

Two by-products of this situation are to be noted. First, the unprecedented refugee problem which it has created—unprecedented partly because of the violence and extent of the persecution, partly because of the nationalist unwillingness of other States to absorb new alien elements; secondly, the distortion of truth which it has brought about, with resultant lowering of the quality of scientific research in the countries concerned. A biological analogy here would seem to be the incredibly small size of the brains of the giant Mesozoic reptiles.

The fourth great feature of the present is the trend away from *laissez-faire* and individualism towards planned organization and collective action. During the period of rapid industrial expansion in the nineteenth century, *laissez-faire* individualism worked well enough, in spite of all its attendant horrors of slums, exploited labour and imperialist expansion. Indeed, it is probable that no other system could have so rapidly mastered the forces and resources of the world. But to-day, like war, it is defeating its own ends and proving unsuitable for its functions. It is proving unsuitable for four reasons; first, because unplanned individualisms, as the world contracts, tend to cancel each other out; secondly, because its basic time-span is too short for many types of projects—the individual demands a return on his money within his own lifetime, or at least for his children. Thirdly, because the agent is too localized; the individual demands a return to himself or to his family, whereas many projects are desirable by making a return to the community in general, through better health, greater taxable capacity, higher standard of living and increased consumption demands, and so on. Fourthly, because it prompts the recurrent vicious cycle of trade boom and trade depression.

Already the world has moved far from simple *laissez-faire*; but the present system is a compromise, and the agencies of collectivized planning are as yet extremely imperfect.

The fifth point is the gradual evening out of world resources in raw material and power. This has been accomplished partly by new methods (for example, utilizable nitrogen from the air instead of from Chilean nitrate beds); partly by artificial substitutes (synthetic dyestuffs; artificial silk; plastics); partly by new transformations of old sources of material or power (motor spirit from coal; hydro-electric power); partly by substituting new raw materials for old (aluminium for heavy metals). The net result has been that, while many inequalities of distribution remain (U.S. helium; Canadian nickel, etc.), the bulk of natural resources is becoming much more uniformly spread over the habitable globe.

The sixth striking feature of our time is the great increase in leisure—some of it in the compulsory form of unemployment and retirement at comparatively low ages. (During actual war, much of this leisure is of course abolished.) The totalitarian countries have made some interesting attempts to provide social organizations for the better utilization and enjoyment of leisure, but so far in other countries the individualistic *laissez-faire* tradition, which tends to regard State-controlled organization as undesirable interference, has prevented any real evolution in this direction.

Seventhly, there is a new approach to colonial problems. Partly this is due to the jealousy of the 'have-nots', a normal phenomenon whipped up to exceptional intensity under the pressure of nationalistic feeling; but in large measure it is due to a new attitude, which has already found expression in the mandatory principle, and to a dawning realization of world unity and the part to be played therein by peoples whose social development has been retarded.

We have drawn one evolutionary analogy—that of the over-armed and under-brained reptiles of the late secondary era. We cannot, however, suppose that the subsequent course of biological evolution will serve as a pattern for the next phase in our own history. This would imply that the over-armed nation-States would disappear and their places be taken by smaller nations more concerned with flexibility and intelligence of social behaviour. This is ruled out by the shrinkage of the world. Do not let us forget that man differs from all other major biological types in consisting of but a single inter-fertile species, in possessing much greater control over the environment, and with the power of forming much larger communities. The only possible climax for such a type is that it should extend over the entire habitable globe in the form

of a single community, whatever the organization of that world community may be. All intermediate stages, of racial, tribal, national groups, are, in the long perspective of evolution, inevitably unstable.

But for the immediate future, both biological analogy and historical experience demand a step-by-step advance. Some functions are sufficiently advanced to be put on a world footing without dislocation, while for others the step can only be on to a regional basis. The chief functions which could be stepped up to a world platform are those concerned with primary products and raw materials, with certain aspects of research and of communications, and with sea-power. The chief functions for which we must be content with the intermediate regional set-up are the political, in the broad sense of the word.

Let me amplify this second point first. National culture and tradition, usually combined with language, is the strongest political force in the world to-day. So-called race problems, when analysed, always turn out on analysis to owe their acuteness to differences in culture and economic level which happen to be associated with genetic differences. It is wholly premature to envisage any immediate world-government which could stand up to the tensions introduced by existing differences in national culture. Regionally, however, there is a hope.

The U.S.S.R. has already established a federal system over one-sixth of the world's land area. Pan-America is beginning to emerge. The present struggle between Japan and China could without too great difficulty be forgotten in a Far Eastern federation. Malaya and tropical Africa are destined by Nature to take their place as world regions as their inhabitants progress toward economic efficiency and political self-government. Finally there remains Europe, in the cultural sense of the area where Western civilization arose and where it still flourishes, however impeded by the barriers of nationalism and the counter-currents of totalitarian philosophy—regionally the geographic Europe minus European Russia but plus the Asiatic and African fringes of the Mediterranean Sea.

The most urgent political post-War task is the settlement of Europe. It is here that the greatest number of powerful nationalisms occur, here that they are most crowded, here that the ownership of tropical territories is chiefly concentrated. Geography and history dictate a regional solution for this area, now torn by war. And the War is a civil war, between different representatives of the European tradition—the tradition based on Greece, on the Roman Empire, on Christianity, on representative government, on the spirit of modern science and industry.

Yet the differences between the various nations or groups of nations within Europe are so great, their separate traditions within the enfeebled European tradition so strong, that it would be hopeless to attempt at one bound a full-fledged federal system like that of the United States. On the other hand, a League system, even if confined to Europe, will not be enough; the experiences of the League of the American States prior to their federation reinforces the lesson of the last twenty years. A League system will not work because it is a contradiction in terms: the absolute sovereignty of its member States is irreconcilable with collective action for the benefit of the whole. Some abrogation of sovereignty—in other words some step towards federation—is essential.

What is the minimum degree of federation which would be effective? An executive organ, an advisory organ, an organ of discussion, a training organ, an organ of opinion, a budget, and, in the present state of the world, alas, an armed force. The executive organ would be restricted to a council, in which smaller countries could be represented groupwise. The organ of discussion would be some sort of assembly, not necessarily elected by Western democratic methods, but representing functions as well as regions. For training there is needed some form of international staff college; for moulding opinion back toward unity and away from nationalist separation, a broadcasting service and perhaps a film unit and newspapers and periodicals. The budget might be raised as a percentage levy or in various other ways: the one essential is that it should be adequate in amount—at least a hundred million pounds per annum. Inadequacy of finances was one of the reasons for the failure of the League. The extent of the inadequacy may be seen from the fact that the total of the contributions of member States during any of the last few years was just about as much as what the London County Council spent annually on main drainage alone! As for armaments, if the European council alone disposed of military planes, heavy tanks and heavy artillery (the manufacture of which cannot be kept secret), effective disarmament, both qualitative and quantitative, could be imposed on member nations, and yet Europe as a whole would dispose of a powerful force. The units of the force should presumably be stationed whenever possible in the territory of small nations; that would be an important contribution on their part to collective security.

The budget would be mainly employed, apart from armaments, on long-term development schemes which would not readily attract private capital—partly in Europe (and there mainly in the less-developed nations, though special projects

could be contemplated in any country), partly in the colonial dependencies. But a reasonable fraction would be reserved for the other European agencies and for leisure organizations on a European scale.

To these last I shall return. Meanwhile let us consider world organization. The most important of these would deal with primary products and raw materials, and their basic function would be first to iron out the vicious cycle of slumps and booms, and secondly to promote a higher standard of living through higher consumption. The League has been blamed, perhaps rightly, for its lack of proper organization on the economic side. It is, however, fair to remember that in 1919 the machinery for large-scale control of raw materials was virtually non-existent. Most of it was called into being by the great depression of 1929 and subsequent years. It exists in the form of cartels and other international schemes for commodity control. From the technical aspect of economic machinery, these have been much improved during the last decade : it remains to alter their direction, to harness them in the interests of consumption and of the general public instead of permitting the dominance of a policy of restriction and short-term profits for sectional interests. From the technical point of view, the provision of really adequate buffer pools and the wholehearted application of scientific research would also lead to improvement.

They would be under a Permanent Commodities Commission of the League of Nations or whatever world international organization took its place. In addition, such a body would have the duty of canalizing world long-term investments for development purposes, partly in the form of rural loans and the like, partly indirectly through the setting up of development commissions and of what might be called international chartered companies, to promote the general development of backward areas. Development commissions, somewhat on the pattern of the Tennessee Valley Authority, would be suitable for self-governing areas where co-operation can be effected with local government authorities ; while the chartered company type of organization will be needed for dependent (non-self-governing) territories. Such bodies would (as with similar semi-public organizations like the London Passenger Transport Board) be compelled to return all profits above a fixed rate into the area for which they were responsible.

We may take colonies next. Here, as with Europe, the task is to steer a safe course between the Scylla of doing nothing and the Charybdis of attempting too much and seeing the shaky edifice collapse. It is easy enough to say, as many people are saying, that all colonies should be handed over in the immediate future to an international commission. But would it work ? Those who know something about native peoples and the problems of tropical administration say no. There must be somewhere in the system a firm organ of authority and an adequate focus for the loyalty both of those administered and those who administer them. Until the incipient federation of Europe that we have outlined grows into a true federal government, and until training and tradition have produced an *esprit de corps* in the international administrative service, these essential organs of colonial administration will not exist internationally. To take a somewhat remote and yet valid biological analogy, before the adequate development of the cerebral cortex, lower vertebrates had to delegate most of their behaviour to a rather poorly co-ordinated system of reflexes and simple instincts.

The remedy would seem to be retention of the principle of national and executive authority at the periphery, with a reasonable and increasing degree of international non-executive control at the centre. The separate colonies and their administration would remain British, French, Belgian, and so on, though they should all be put on the footing of mandates, and the Mandates Commission strengthened by the grant of powers of investigation on the spot in addition to mere review of policy. Under the European council would be established a colonial commission, truly international, with small but picked international staff of research workers, experts and travelling advisers, and the power of allocating considerable grants out of the European common budget for education, for health, for conservation, for roads and other public works.

It would be desirable that a small but progressively increasing fraction of the technical and perhaps later of the administrative posts in the local service should be thrown open to nationals of other countries ; but the appointments should be in local hands, not in those of the international authority.

A somewhat similar system works quite successfully between the Federal and State authorities in the Tennessee Valley Authority, and it ought to work well enough in the colonial sphere. The scheme would have to be modified in the minor colonial areas, such as the Caribbean and the Pacific, to allow of the participation of other powers, for example, the United States and some of the British dominions.

Do not let us forget that international administration is *per se* no solution of the basic colonial problem, which is the development of the colonial territories and their inhabitants towards self-

government. It could only help at the European end, in reducing jealousy among the great powers. But even the partially international scheme set forth above would remove most of the political objections to the transferring of colonial mandates to other powers.

Meanwhile the world organization, too, through its international chartered companies, its world loans, and its expenditure on research, would be aiding in the progress of the tropical countries. The international staff college would have its colonial section, and after perhaps a generation, there would have been built up a truly international *esprit de corps* among the staff.

I mentioned the growth of leisure and the need for its better organization. This is especially urgent in Europe, for it will be largely through such organization that the people of its separate countries will be able to understand the European tradition and to participate in it, only so to experience the greater European loyalty which will render the lesser national loyalties innocuous, a source of local but co-operative pride instead of a source of jealousy and hate.

To do this, the democracies must learn from the totalitarian States ; they must build up their own leisure organizations, and then extend the principle internationally. One can think of so many ways in which such organizations could promote "life, liberty and the pursuit of happiness" on the international plane. Properly organized travel in international parties ; youth hostels, walkers' and climbers' hostels, all over Europe. International festivals like Salzburg in the old days, or Oberammergau, but more numerous and made available to many more people ; an international system of holiday camps, of summer schools, of study and hobby groups, of retreats, dotting Europe from end to end. The whole could easily be linked up with the extension of the exchange system which will be necessary on the educational side—exchange of undergraduates, of graduates, of teachers and professors, to a certain degree of schoolboys ; and also with international schemes of refresher courses for administrators and professional men of every description, and of adult education. One may even envisage the substitution of citizen service for military conscription, and the placing of that, too, on a broad inter-European basis. In all such ways, Europe could become a reality to its inhabitants, and the onward flow of its great cultural tradition would be reinforced.

Let us try to envisage what improvements such changes would bring about. Nationalism and self-determination would not disappear ; but they could be relegated to the cultural sphere, as has been done within the U.S.S.R., and banished from that of economics and power politics. Political boundaries and national Governments would continue to exist ; but their importance, and especially their importance in causing trouble, would be reduced. The risk of conflict between major regions would remain until the time was ripe for world as opposed to regional federation. But the financing of development schemes in the poorer or less advanced countries, and the reduction of economic distress by ironing the bottom out of depressions and by planned schemes for world production and distribution of raw materials and primary products, would remove some of the chief causes of unrest and war.

Friction and difficulty will remain : we have the fundamental biological analogy of hostile symbiosis of the parts within the body to remind us of that. But man and his societies are organisms, albeit with their own unique nature ; and the equally fundamental biological analogy between animal and social evolution shows us that the difficulties can be overcome, and the friction of the parts subordinated to and even utilized for the benefit of the whole.

But do not let us delude ourselves into thinking that it will be easy. Wishful thinking issuing in impractical schemes is one of man's unique biological attributes. Historical experience demonstrates that the most important line of evolutionary progress has been through the improvement of brain mechanism, notably the mechanism for acquiring knowledge and correlating it with action.

The corresponding social machinery is yet in its infancy. The end of the War will face the world with a task for which it is ill prepared. But again, do not let us attempt any ideal or complete plan, any grandiose scheme for which the world is not ripe. That was one of the causes of the League's failure : it was an attempt to impose a ready-made plan, and public opinion was insufficiently prepared for any idea of world citizenship. Rousseau and the Encyclopædists had been preparing opinion for a radical change in society for half a century ; without that, the French Revolution would have been a fiasco. The idea of supernational organization had not penetrated beyond a limited circle of intellectuals, and even they had not had time to work out their ideas in detail, before Wilson sought to impose it in reality. To-day we have at least had twenty years of discussion, together with some bitter if salutary experiences. If the leaders of thought in the various nations can now work out a less pretentious but more workable plan, and at the same time can prepare public opinion for the idea of a dual citizenship, national and world, this War may be the occasion for taking a small but decisive step away from war and towards a world organization of humanity.

CANCER-PRODUCING CHEMICAL COMPOUNDS

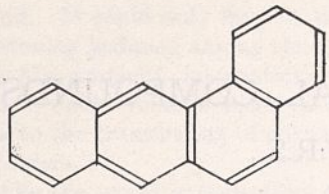
By Prof. J. W. Cook, F.R.S.,
University of Glasgow

IN the last resort, the degree of importance which is attached to the carcinogenic substances depends upon whether such compounds are concerned in the etiology of 'spontaneous' human cancer. Perhaps closely bound up with this question is another unsolved problem of outstanding importance, namely, the manner in which these compounds bring about a transformation of normal cells into malignant cells. At least until answers are forthcoming to these questions, the carcinogenic compounds will continue to furnish useful material for the experimental study of cancer. Industrial cancer, in its various forms, has stimulated the researches which have brought to light the cancer-producing properties of the various carcinogenic agents, and in the preparation of the present brief survey of these agents regard has been paid to the correlation of the various forms of industrial cancer with their causative compounds.

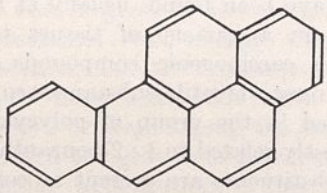
In the earlier work on the carcinogenic properties of substances the skin of the mouse was usually employed as the test object. This was due to a number of reasons. Results could be expected comparatively rapidly; the ear of the rabbit, which had been first used, was less satisfactory in this respect. Moreover, the modes of application of the substances under examination were considerably restricted by the toxic and inflammatory properties of the crude mixtures which it was necessary to use. Many of these difficulties have been resolved by the availability of pure chemical compounds of high carcinogenic potency, and in recent years new techniques of administration have been developed, so that malignant tumours have been induced in a large number of different tissues, and in several different species. One outcome of these and other studies has been the revelation that, in certain strains of animal, tumours of a particular organ are apt to occur spontaneously. Thus, some strains of mice show a high incidence of mammary carcinoma; other strains show a high incidence of lung cancer; and there is at least one strain of mice in which liver-cell cancer (hepatoma) is apt to arise spontaneously. These findings indicate the caution that must be used in interpreting the results when cancers of such organs are found in experimental animals, especially when the tumours arise at sites other than that of application of the carcinogenic agent. Yet even so, tumours clearly attributable to the treatment have been found, usually at the site of application, in a variety of tissues of animals treated with carcinogenic compounds. In this respect the most versatile substances so far found are contained in the group of polycyclic hydrocarbons, mostly related to 1 : 2-benzanthracene (I), in which substituents are present at certain well-defined positions in the molecule. With these compounds malignant tumours have been obtained, usually in mice and rats, in such tissues as the skin, the subcutaneous tissues, the peritoneal cavity, the liver, the prostate, the forestomach, the brain, and the spleen; and this list is not exhaustive. Less widespread in their effect are members of other classes of compounds, where usually carcinogenic action has not been shown except in a single organ. In this connexion it needs to be borne in mind that these substances have not usually been so widely investigated as the polycyclic hydrocarbon class.

The earliest form of industrial cancer, recognized as such in the latter part of the eighteenth century, was the cancer of the scrotum to which chimney sweeps were specially liable. This was caused by soot, and the pursuit of the clue so provided culminated eventually in the isolation from coal tar of the individual compound responsible. This is 3 : 4-benzpyrene (II), an aromatic hydrocarbon, the relationship of which to 1 : 2-benzanthracene (I) is apparent from the formulæ. 3 : 4-Benzpyrene is undoubtedly the principal cancer-producing constituent of coal tar. It has a high boiling point, and hence is present to an appreciable extent only in the highest boiling fractions of the tar. There are grounds for inferring that this or a similar compound is responsible for the carcinogenic properties shown to varying degrees by some of the mineral lubricating oils. Prolonged contact with industrial products of these types is now recognized as being fraught with danger, and the use of suitable precautions should lead to diminution if not to eradication of the form of industrial cancer which they are liable to cause.

The widespread use of tar in road surfaces, and the publication of statistics which appear to show that cancer of the lung is increasing at an alarming rate, have led to the suggestion that tarred road dust may be partly responsible for this increase. This suggestion has been tested experimentally;



(I)



(II)

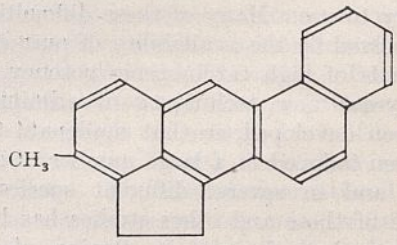
but although an increase in lung cancer was found in mice breathing air impregnated with road dust, this increase was not wholly related to the presence of tar in the dust, and the results of the experiments do not directly implicate such an agent in the increase of the human disease. Furthermore, it is considered by many authorities that the recorded increase in lung cancer is largely accounted for by improved methods of diagnosis. Unconvincing attempts have also been made to implicate pollution of town air by soot, exhaust fumes, etc., and also tobacco smoking in the increase of lung cancer. However, the knowledge that the agencies in question may be, and sometimes are, associated with carcinogenic substances, does not allow such speculations to be too lightly dismissed.

The carcinogenic activity of 3 : 4-benzpyrene is of a high order, inasmuch as tumours arise in a large proportion of the treated animals, in a relatively short time. A somewhat greater potency is shown by 20-methylcholanthrene (III), a hydrocarbon first obtained by chemical transformation of the bile acids, and later indirectly from cholesterol. Other hydrocarbons of similar structure have similar high activity. An altogether higher order of activity, judged by the criterion of shortness of the latent period in the induction of skin tumours in mice, has recently been found in a small group of hydrocarbons typified by 9 : 10-dimethyl-1 : 2-benzanthracene (IV). These compounds, which are characterized by the presence of methyl groups in the positions shown, have in mice skin given tumours which frequently made their appearance within a month of the first application.

It will be observed that the carcinogenic hydrocarbons thus far mentioned are all derived from 1 : 2-benzanthracene (I). A very considerable number of other carcinogenic derivatives of 1 : 2-benzanthracene is now known. These are purely synthetic compounds, not known to be associated with either industrial or naturally occurring products. Their chief interest lies in the large number of closely related compounds which have been shown to have such biological activity, and in the generalizations which it has been possible to arrive at regarding the correlation of carcinogenic activity with molecular structure and with other properties.

The benzanthracene group is not the only group of polycyclic hydrocarbons with carcinogenic properties. Feeble activity is shown by 3 : 4-benzphenanthrene (V), and systematic examination of homologues and derivatives now in progress is pointing to the conclusion that much enhanced activity is shown when suitable substituents are introduced into positions 1 and 2, but not into other positions of the molecule. Before 3 : 4-benzpyrene had been isolated from coal tar, it had been claimed erroneously that chrysene, also a coal tar constituent, had carcinogenic properties. This error appeared to be due to the incomplete purification of chrysene of coal tar origin. These and other circumstances have caused some attention to be devoted to chrysene derivatives, and a number of chrysene homologues, selected in a haphazard way, have been synthesized and found inactive when tested biologically. More recently a consideration of the structural relationship among the carcinogenic derivatives of 1 : 2-benzanthracene and 3 : 4-benzphenanthrene led C. L. Hewett (*J. Chem. Soc.*, in the press) to synthesize 1 : 2-dimethylchrysene (VI), and this hydrocarbon has been found to have definite carcinogenic activity when tested by application to the skin of mice.

For many years it has been recognized that the operatives engaged in certain sections of the



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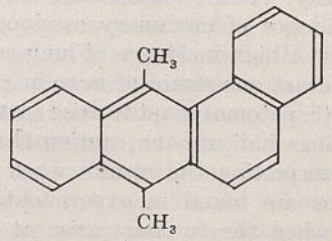
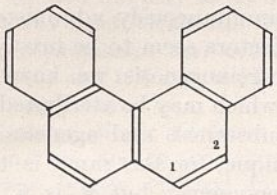


(IV)

chemical industry, and especially in the manufacture of dyestuffs, are more liable to cancer of the urinary bladder than is the general population. This form of cancer was long known as 'aniline cancer', and the prevailing opinion for many years has been that it is due to absorption of nitrogenous bases such as benzidine and the naphthylamines, especially β-naphthylamine. Until recently the evidence was purely circumstantial, and many unsuccessful attempts have been made to induce experimental tumours with these bases. Some two years ago, however, the production of bladder tumours in dogs given, subcutaneously and orally, large daily doses of a high grade of commercial β-naphthylamine was reported by American workers. It was doubtless the prevalence of this dye-workers' cancer, coupled with the known cell-



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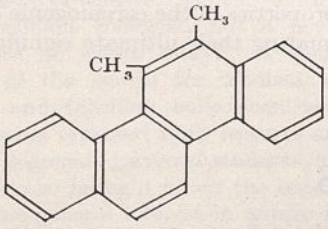
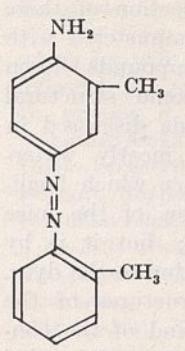


(VI)

proliferating properties of Biebrich Scarlet *R*, which led to Japanese researches which have shown that a number of relatively simple azo compounds have carcinogenic properties. The principal active compounds which have been revealed by this work are 4′-amino-2 : 3′-azotoluene (VII), which gives liver-cell tumours when fed to rats and mice, 2 : 3′-azotoluene (VIII), which gave malignant tumours of the urinary bladder in rats, and *p*-dimethylaminoazobenzene (IX), which is mainly carcinogenic towards the liver.

In view of the possibility that contaminants of the naphthylamines might be responsible for the dye-workers' cancer, a number of possible transformation products have been administered to rats and mice in the research laboratories of the Royal Cancer Hospital, London. Mice treated with 2 : 2′-azonaphthalene (X) by application to the skin, or by subcutaneous injection, or by feeding, have developed many liver growths, some of them liver-cell carcinomas, but most were of a cholangiomatous type. Similar tumours were obtained with 2 : 2′-diamino-1 : 1′-dinaphthyl (XI), a product



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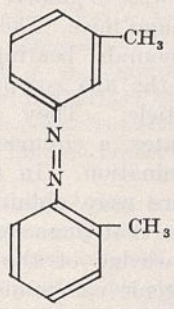

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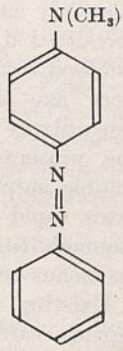
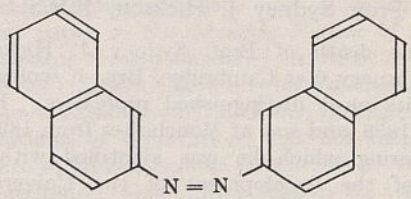


(IX)

which arises easily by intramolecular change of the dihydride of (X), and also with 3 : 4 : 5 : 6-dibenzcarbazole (XII), which is formed by deamination of (XI). There is thus the possibility that the biological effects of this series of compounds are due to a common metabolite, and it is worth noting that the final product of the series (XII) has a structural resemblance to the carcinogenic polycyclic hydrocarbons.

One of the azo dyes found to be carcinogenic to the liver by the Japanese workers, namely, *p*-dimethylaminoazobenzene (IX), was formerly used as a food colouring matter under the name of 'butter yellow' and has also been used in dyeing leather. Fortunately, its use in these respects appears now to be obsolete. In Great Britain the range of permitted food colouring matter is now very limited. With the co-operation of the Government Chemist, tests have been carried out in which



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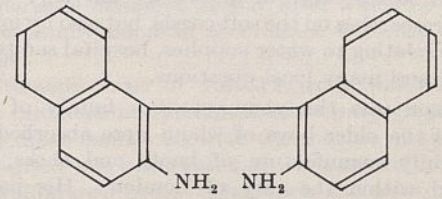

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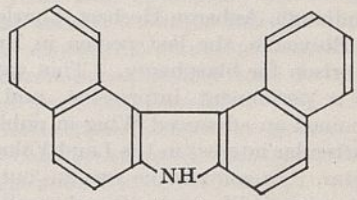


(XII)

relatively large amounts of a selection of these permitted dyes were regularly administered with the food to rats and mice. The compounds chosen were azo compounds bearing some structural resemblance to the azo compounds discussed in the present article. They are mostly water-soluble sulphonates, a circumstance which facilitates rapid elimination. In a few of the mice stomach tumours were obtained; but it is by no means certain that these were due to the dyes.

Existing knowledge of the structures of the various carcinogenic compounds and of the conditions under which they may be formed has led to various speculations regarding the possibility of such substances being present in human food. Some workers have recorded the production of skin tumours by heated fats and by tars prepared by heating coffee. It has been claimed also that wheat-germ oil prepared by a special extraction process produces sarcomatous tumours in rats. This claim has not thus far received independent confirmation, and at the present time there is no evidence that cancer of the internal organs is due to specific dietary constituents. However, it is evident that such lines of inquiry should be pursued.

A puzzling and in some ways disconcerting feature of the carcinogenic agents now known is their variety and their apparent lack of correlation. It may be recalled that cancer may be induced not only by the classes of compound reviewed in this article, but also by several other agencies. The malignant tumours which arise in consequence of exposure to ultra-violet light, X-rays, and radioactive substances may well be due to the production of carcinogenic compounds from normal constituents of the tissues.

There is, however, no evidence that the radiations exert their influence in this indirect manner. Cancer of the skin occurs in persons taking arsenic by mouth over long periods, and has also been found in workmen engaged in handling arsenical sheep dips. Teratoma of the testis in fowls can be induced by injection of zinc salts at the season of the year when the testis is actively secreting androgenic hormone. At other times also this type of growth may be produced if gonadotropic hormone is simultaneously administered, so that at least two factors seem to be involved.

Thus, in carcinogenesis we have a biological phenomenon which may be attributed to a variety of different substances and agencies. This is by no means unique, for the same is true of other biological phenomena; but it is a circumstance which adds to the difficulty of interpreting the biological properties of the carcinogenic compounds and in estimating their ultimate significance.

OBITUARIES

Prof. Sydney J. Hickson, F.R.S.

BY the death of Prof. Sydney J. Hickson on February 6 at Cambridge, British zoology loses one of its most distinguished professors. He was born in 1859, and was at Manchester from 1894 until 1926, during which he was identified with every aspect of the development of the University of Manchester. At the same time he annually contributed to the store of knowledge not only by his special researches on the soft corals, but also by investigations relating to water supplies, hospital sanitation, poultry and many local questions.

Hickson was the youngest of a family of nine, most of the older boys of whom were absorbed into the family manufacture of boots and shoes, then situated within the City of London. His parents were of Unitarian stock with advanced social views, and among their visitors he recalled Mrs. Besant, Charles Bradlaugh, Auberon Herbert, Charles Voysey and G. T. Holyoake, the last person in England to be sent to prison for blasphemy. This early intercourse left a permanent impression, and Hickson always remained an advanced Whig in public affairs, taking a particular interest in the Land Values League of Manchester. In contrast he was an 'out and out' Tory in his ordinary life, and a friend recalls his top-hatted, athletic figure on its morning walk from Withington to the laboratory.

Hickson's early education was at the Mansion Grammar School at Leatherhead, a beautiful old domain on the River Mole. Here he followed his brothers and acquired a taste for Nature, as Ray Lankester had done at the same school. In 1893 he entered University College School, passing on to the College in 1876, where he was so enthralled by Lankester's lectures—the courses commenced at 8 a.m.—that the following year he was Gold Medallist. Then he went on to "Barts", but he found conditions "indescribable and terrifying", Klein's course on histology being to him their one redeeming feature. Lankester advised Cambridge, and there in the laboratories of Michael Foster and F. M. Balfour he found his vocation and made many friends, Sedgwick, Haddon, Bullen, Caldwell, Threlfall and many others. He obtained a first class in the Tripos of 1881; but he had already, by dissecting, teasing and the use of the sliding microtome, begun his laborious studies of the eyes of Pecten and Spondylus; each section was removed and mounted separately by hand, for Threlfall had not yet made his automatic microtome. Similar technique was also employed for his now classical research on "The Eye and Optic Tract of Insects", 1885.

In 1882 Hickson became demonstrator to Moseley at Oxford. His interests henceforth were mainly marine and directed towards those sedentary forms of life upon which his professor had done such brilliant work. He was in Celebes for a year, much of it camped on the shore of Talisse Island; but illness drove him to the higher lands of Makassar, where he studied native life. His results are published in "A Naturalist in North Celebes", which is distinguished by its vivid descriptions of shore life. In 1888 he was deputy professor at Oxford and in the next year accompanied his uncle, Sir Sydney Waterlow (formerly Lord Mayor of London) on a year's tour of Canada, United States and Mexico. In 1890 he returned to Cambridge as lecturer in advanced zoology. Gadow, Harmer and Shipley were his colleagues in these courses—a highly distinguished team, with Sedgwick to lead them. Each lecturer had his own technique and they were equally successful, for each allowed full play to his own psychology. Hickson was the most vivacious. There were gaps in anatomy, relationships and evolution; but his beasts were 'alive and kicking', to his pupils' obvious interest and enjoyment.

Hickson became Beyer professor of zoology at Manchester in 1894, and to the regret of his friends his gaiety was largely eclipsed by that load of executive cares which are inseparable from the life of a professor of science. He succeeded Milnes Marshall, a brilliant zoologist, but a new broom has always dust to sweep away. A complete reconstruction of the course for medical students was necessary and teaching collections were deficient. The professors repeated their lectures and practicals to strictly segregated women students, and Hickson's refusal to do so brought about the necessary reform. At this time general interest in nature study and in science in schools was almost negligible in this busy commercial part of England. The new professor recognized this as a serious detriment to university work and set himself to remedy it, especially advocating nature teaching and school museums. Indeed, Lancashire's high position in these respects is largely due to Hickson and the public-spirited men who struggled to remove the financial difficulties which separated the schools from the universities.

The newspapers contain reports of numerous open lectures, especially in connexion with the Manchester Museum, and addresses to 'brotherhoods', excursions and discussions. The City Microscopical Society was his especial interest, and in his turn he was president of the Literary and Philosophical Society. He was a protagonist for the woman students, and the creation of their hall, athletic and other activities was largely due to him; but perhaps he found the most fertile place for his ideals in the development of the Manchester High School for Girls.

On Saturday afternoons Hickson was always to be found on the University Athletic Ground, of which he was the permanent treasurer, often in summer handling a bat. At the same time he was active in all that concerned the governance of the University, being noted for his 'wise' opinions both on the Council and as dean of the science faculty. The growth and happiness of the University was greatly helped by that tradition of hospitality among its professors which his wife loved to foster, little dinner parties followed by good conversation, always humorous. In science it was a distinguished professoriate, including Alexander, Rutherford, Weiss, Elliot Smith, Dixon, Stopford (now vice-chancellor), Perkins, Lamb, Boycott, Reynolds, Loraine Smith and Hopkinson as vice-chancellor.

In 1895 Hickson was elected to the fellowship of the Royal Society, mainly on a series of papers elucidating the relationships of the soft corals (Alcyonaria). These became his chief theme of study for the rest of his life and he was universally recognized as the chief authority on them. His last paper dealt largely with the effect of symbionts and is now in the press. They were, too, the subject of his addresses as president of Section D of the British Association in 1903 and as Croonian lecturer of the Royal Society in 1916. In 1926 he retired to Cambridge. His mornings were devoted to his research, which, if anything, showed increased mastery, while his afternoons enabled him to display one of the best-kept and varied of small gardens, so different from his Manchester essays in horticulture. He was happy in the past and the present, cared for by his wife, who had been his pupil in his earlier Cambridge days. They had two children, one of whom is a child-specialist at Manchester, while the other, as secretary of the Extension Board at Cambridge, pursues an objective which his father at Manchester advocated forty-five years ago.

J. S. GARDINER.

Mr. E. N. Nevill, F.R.S.

MR. EDMUND NEVILLE NEVILL died on January 14 at his home in Eastbourne at the age of ninety-three. His contributions to science were in astronomy, and his first paper in the *Monthly Notices of the Royal Astronomical Society* appeared in June 1873. This paper was entitled "Note on the Possible Existence of a Lunar Atmosphere", in which he suggested that observations of occultations did not disprove the existence of an atmosphere on the moon. Altogether he contributed about fifty papers to the Royal Astronomical Society and until 1888 he wrote under the name of Edmund Neison, after which he reverted to his family name in accordance with the terms of a will.

Although most of Nevill's work was associated with problems in dynamical astronomy, in particular with those connected with the motion of the moon, he carried out observational work as well. In 1876 his well-known book, "The Moon and the Conditions and Configurations of its Surface", was published, and ten years later he brought out a work with the title, "Astronomy, a Simple Introduction to a Noble Science". Among his numerous contributions to the Royal Astronomical Society may be mentioned an important paper in November 1878 which showed that ancient eclipses indicated a greater value of the moon's secular acceleration than the Arabian observations suggested. He showed that it was possible to effect a reconciliation by postulating a term with a

period of one to two thousand years and a coefficient three or four times that of Hansen's, and he expressed doubts regarding the existence of tidal retardations in the rotation of the earth. In a number of other papers he dealt with similar subjects, showing the presence of terms in the moon's motion due to the direct action of the planets, the value of the long inequality due to the disturbing action of Mars, lunar perturbations arising from Jupiter, etc. In the last point he was many years ahead of all other workers in the same field. His research in dynamical astronomy was not confined to lunar work and his versatile mind was able to turn to other branches. As one example, reference may be made to an important paper in 1879 with the title "On the General Solution of the Problem of Disturbed Elliptic Motion". An example of his interest in observational astronomy is shown by his work with a Newtonian reflector of $9\frac{1}{3}$-inch aperture on the satellites of Saturn. He communicated his results to the Royal Astronomical Society in 1876 and dealt with his observations of Titania and Oberon, which he was just able to observe under favourable conditions.

In 1882 Nevill went to Natal to observe the transit of Venus, and as a result of the interest aroused in astronomy, a semi-public observatory was established through the generosity of certain residents in Durban assisted by the Corporation. Later, when this was taken over by the Government of Natal, Nevill was appointed the first director. Not only did he carry out the ordinary routine work of the observatory, but he also conducted research in his favourite subject and deduced new values for lunar elements. Reference has been made earlier to the results of some of this research. Unfortunately many of his results, including his lunar tables, still await publication. After his retirement from the observatory he does not appear to have done very much work, and the last paper that he contributed to the *Monthly Notices* was in May 1915 entitled, "On the Conjunction of Stars with the Moon, recorded by Ptolemy". He was elected a fellow of the Royal Astronomical Society in 1873 and a fellow of the Royal Society in 1908.

Mr. B. D. Porritt

THE death of Mr. B. D. Porritt, on January 28, came as a shock to his friends despite the long illness that had foreshadowed it.

Mr. Porritt was born of Yorkshire parents in Canada in 1884, and was educated at the Whitgift Grammar School, Croydon; at University College, London, where he graduated in chemistry in 1908; and at Heriot Watt College, Edinburgh. He joined the North British Rubber Co., Ltd., where he was chief chemist in 1912 and research superintendent in 1916. He left the Company in 1920 to assume the directorship of the Research Association of British Rubber Manufacturers, then inaugurated under the co-operative research scheme of the Department of Scientific and Industrial Research.

The chemistry and physics of the rubber industry in 1908 was much more primitive and ill-informed than to-day, and Mr. Porritt had a wealth of problems before him from the beginning. In the early years, he made useful contributions to analytical and testing methods for rubber. This interest continued throughout his life, for in later years he concentrated an enormous amount of fine detail work on the standardization of testing methods, and was a leading spirit in establishing the Rubber Industry Committee of the British Standards Institution.

Observations of a more fundamental nature were made, as early as 1920–21, on the then unsuspected photopolymerization of rubber solutions, and on the role of oxygen in the mastication of crude rubber. Both these subjects have since received much development in other hands.

Another early interest, which he was able to pursue at length for himself, was the study of the surface breakdown of hard rubber under the influence of light. He contributed also many observations on the swelling of rubber in non-aqueous liquids and on the factors influencing that obscure phenomenon. One of his last interests was the production of crude rubber in the form of fine powder, and the utilization of the new product in novel processes.

By way of a hobby, Mr. Porritt was the British rubber industry's historian, and his "Early History" has long been the classic source for all subsequent writers in this particular field.

The story of B. D. Porritt would be quite incomplete without stress being laid on his tireless work in promoting co-operative research. He commenced in and with the Rubber Research Association when the industry's interest was so lukewarm that only fifteen member firms supported the idea; he left it at his death with more than 170 member firms. This progress and success was due mainly, if not wholly, to his untiring efforts in promoting the co-operative principle, and to the sound work of the organization which he built up. His flair for organization, indeed, extended in many directions. He made a notable success of the Rubber Exhibition at the London Science Museum in 1934–35, and was a leading promoter of the Rubber Technology Conference of the Institution of the Rubber Industry in 1938.

He was author of a small book, "Chemistry of Rubber", in 1913, and co-author of the now well-known reference handbook, "Rubber, Physical and Chemical Properties", in 1935.

T. R. DAWSON.

WE regret to announce the following deaths:

Mr. K. E. Heesom, inspector of mines, Sierra Leone, on February 11, aged forty years.

Prof. J. H. Michell, F.R.S., professor of mathematics during 1923–1928, and honorary research professor of mathematics since 1928 in the University of Melbourne, on February 3, aged seventy-six years.

Prof. E. Soler, emeritus professor of theoretical geodesy in the University of Padua, vice-president of the International Association of Geodesy, on January 24.

Prof. Margaret Floy Washburn, professor of psychology at Columbia University, author of "The Animal Mind", aged sixty-eight years.

NEWS AND VIEWS

American Association: New President

DR. ALBERT FRANCIS BLAKESLEE, director of the Carnegie Institution Station for Experimental Evolution, Cold Spring Harbor, U.S.A., has been elected president of the American Association for the Advancement of Science. This election will be welcomed all over the world, because he has a high reputation as a botanist and as a pioneer in more than one line of research, while his genial manner and ever-ready help to all scientific workers are very well known. His early work, in which he showed that only individuals of a fungus species which were physiologically different could take part in sexual union, initiated a large number of investigations into the behaviour of sexuality in the fungi.

Later, in collaboration with a number of workers he had attracted round him, Dr. Blakeslee analysed the cytogenetics of the thorn-apple, *Datura Stramonium*. The discovery of secondary and tertiary trisomics, and the analysis of their constitution by Blakeslee and Belling was a turning point in modern genetics. Studies of tetraploid segregation in Datura, the production of many haploids and novel chromosome types and the analysis of the effect of changes in the chromosome constitution of a plant by Blakeslee are established as classical reference material. More recently he has been a leader in the utilization of colchicine treatment in the production of polyploid forms. Results of economic importance are already being produced, while a neat use of colchicine is being made for the elucidation of sex-determination in plants. Dr. Blakeslee's wide interests are appropriate to the presidency of the American Association.

University of Cambridge Parliamentary By-election

THE recent by-election in the University of Cambridge to choose a successor to the late Sir John Withers in the House of Commons was of unusual personal interest to scientific workers in that the two candidates must be well known to many of them. Prof. A. V. Hill, Foulerton research professor of the Royal Society, formerly Jodrell professor of physiology in University College, London, has been one of the secretaries of the Royal Society since 1935. Prof. John A. Ryle, regius professor of physic at Cambridge since 1935, has had a distinguished medical career in London, and recently completed a four-year term on the Medical Research Council. Both candidates adopted the adjective 'independent', and while Prof. Hill accepted the support of the Cambridge Conservative Graduate Association, Prof. Ryle preferred to style himself 'progressive'. Prof. Ryle's advantage as a Cambridge resident was offset by the fact that Prof. Hill, as a former scholar and fellow of Trinity College, is well known in Cambridge.

The result of the poll was declared on February 24: Prof. A. V. Hill, 9,840 votes; Prof. J. A. Ryle, 5,386 votes. Prof. Hill therefore goes to Westminster as one of the Parliamentary representatives of the University of Cambridge. In his election address, he claimed the independence usually accorded to university members; in addition, he stressed the importance of international co-operation in attacking the problems which will face the world at the conclusion of the War. He also urged the need for bringing science and learning to bear on national affairs, and said that "science has still too little influence on higher policy in government, in departments and in industry". As regards the universities, their strength must be maintained; industry will require new methods and materials in the recovery phase; improvements in public health must be studied; trained and critical young minds will be needed to meet the problems of reconstruction; and finally, the "free pursuit of knowledge for its own sake must be kept up". Prof. Hill's programme is comprehensive, but no one who knows him will doubt that he will press his views at the proper time with skill and vigour.

Heinrich Wilhelm Matthias Olbers (1758-1840)

ON March 2 a century ago, the city of Bremen lost its most distinguished citizen, the physician and astronomer Heinrich Wilhelm Matthias Olbers, who died at the age of eighty-one years, after a life of unremitting industry. He was born on October 11, 1758, at the village of Arbergen, near Bremen, where his father was pastor, and from his boyhood he was an enthusiastic student of science. When nineteen he became a medical student at Göttingen and at twenty-three set up in practice in Bremen. A conscientious practitioner, he served his fellow-citizens in many ways, and after his death his statue was erected in the city. His astronomical work was done in the upper part of his house in the Sandgasse, which was fitted up to afford a view of the greater part of the sky. His instruments included a 5-ft. Dollond refractor of $3\frac{3}{4}$-in. aperture, a 5-ft. reflector by Schröter, a quadrant by Bird and a Troughton sextant. It is said that he never slept more than four hours at a time.

Olbers is chiefly remembered for his discovery of asteroids and his fifty years' study of comets. In 1772 Bode had discovered the law of planetary distances bearing his name, and when in 1781 Herschel discovered Uranus it was concluded that there was a planet between Mars and Jupiter, and largely through Von Zach, in 1798 a party of astronomers met at Gotha to start a search for it. Another meeting took place at Schröter's observatory at Lilienthal, and zones of search were assigned to twenty-four astronomers. One of these astronomers was Piazzi of Palermo, but before instructions reached him, on January 1, 1801, he

discovered the minor planet Ceres. The search being continued, Olbers, on March 28, 1802, discovered Pallas, on September 1, 1804, Harding discovered Juno, and on March 29, 1807, Olbers discovered Vesta. The fame of Olbers spread far and wide. He represented Bremen at the baptism of Napoleon's son the King of Rome in 1811, and during 1812–13 was a member of the legislative body in Paris. The Royal Society elected him a foreign member in 1804, and the Paris Academy of Sciences in 1829 made him a foreign associate. He was the correspondent of nearly every astronomer in Germany, and through him Bessel became known in the scientific world. Indeed he declared that his discernment of the genius of Bessel was a greater service to astronomy than his own work on comets and planets. He was a man of lovable disposition, generous and unassuming.

Laurent Théodore Biett (1781-1840)

DR. LAURENT THÉODORE BIETT, a celebrated Paris dermatologist, was born in 1781 at Schams, in the Grison canton of Switzerland. Seven years later he moved with his parents to Clermont-Ferrand, where he commenced his medical education under Bonnet, the senior surgeon to the Hôtel Dieu. At the beginning of the century he came to Paris, where he qualified in 1814 with a thesis entitled "Quelques Observations sur la frénesie aiguë idiopathique". Shortly after qualification he was appointed physician to the Hôpital Saint Louis, where he carried out some important improvements, including the establishment of an out-patient department for diseases of the skin, of which he was the director for sixteen years. While attending a patient in London in 1816, he took the opportunity of studying the work of Willan and Bateman, and on his return to Paris endeavoured to introduce their classification of skin diseases, which was in opposition to that drawn up by his friend Alibert.

Biett made many valuable contributions to the treatment of skin diseases, including the use of iron and arsenic internally, the employment of sulphur baths and the application of dry and hot air. His lectures, which were edited by Cazenave and Schedel, appeared in 1828, went through three editions, and were translated into English in 1842 by T. H. Burgess. He also contributed many articles to the "Dictionnaire des sciences médicales", and all the articles on diseases of the skin to the twenty volume "Dictionnaire de médecine", in addition to papers in periodical literature such as the *Bulletin de Thérapeutique*, *Gazette des Hôpitaux* and *Journal universel des sciences médicales*. Being a devotee of the arts, he was the medical attendant of many well-known painters, sculptors and actors. He died of heart disease on March 3, 1840.

Colonial Development and Scientific Research

PUBLICATION of the recommendations of the West Indies Royal Commission together with the important statement of policy on colonial development and welfare (H.M. Stationery Office. Cmd. 6174, 6175), to which Mr. Malcolm MacDonald, H.M. Secretary of State for the Colonies, made reference in the House of Commons on February 20, mark a momentous enlargement in scope in the administrative and financial relations between Great Britain and her colonial and other dependencies of analogous status which will have a profound effect on their future. The measures which the Government now proposes after an examination of Colonial problems which had been begun sometime before the outbreak of the War is an acceptance of an obligation which has long seemed inevitable to those who have been engaged in the scientific investigation of conditions in these dependencies if Great Britain's responsibility is to be met.

In brief, the proposals are as follow : The place of the Colonial Development Fund, instituted in 1929, and limited to a sum of £1,000,000 a year, will be replaced by a greatly increased provision for development and welfare. The sum will amount to not more than £5,000,000 a year for a period of ten years, at the end of which period this provision is to be reviewed. The amount thus made available, is not, however, from one point of view the most important enlargement. On one hand, assistance will no longer be granted, as hitherto in the main, solely to capital expenditure, but recurring expenditure will come under this provision. On the other hand, while certain purposes of expenditure have not been ruled out in terms, assistance has been granted generally to material development. In future this will not obtain ; and such services as agriculture, health, education and housing will be brought into the account.

Nor are the claims of the important question of research overlooked. Hitherto, as Mr. MacDonald pointed out, the Colonial Office has been able to call upon the assistance of scientific and technical experts in dealing with Colonial problems. This service will now be placed upon a permanent basis by the institution of a Colonial Research Advisory Committee, while for dealing with its recommendations a sum of £500,000 a year will be allocated. This will be used to assist in the various fields of research. As already mentioned, these proposals apply not only to the Colonies and Protectorates, but also to the Mandated Territories. The pause, which, as Mr. MacDonald intimated to the House of Commons, must ensue before they can come into full operation, will give the necessary breathing space for the careful preparation of plans.

Tibetan Coronation

IT is perhaps not surprising that, even amid other and insistent preoccupations, the accounts of the final act of the installation of the new Dalai Lama sent by correspondents to the world's daily press, have created a profound impression. Nowhere else, except possibly in Japan, could the inauguration of a new head of the State have so closely wedded the spiritual and the political and civic elements in what is virtually an act of coronation, and at the same time united every member of the population in an expression of combined loyalty and religious fervour.

Throughout the pageantry, the wealth and splendour of display of personal adornment, dress, and equipment vividly described in, for example, the dispatches of the correspondent of *The Times* in the issues of February 23 and 24, there is apparent an all-embracing current of mystic symbolism which endues every act, every movement and every attendant circumstance with the significance of worship, and of recognition of the spiritual influence which centres in and emanates from the person of the reincarnated head of the Tibetan spiritual and political hierarchy. It is this, and not the fact that such ceremonial has not been enacted in Lhasa for the space of sixty years, which animated the crowds through which the Dalai Lama was carried in his golden palanquin to the Potala, and on the following day added a solemn meaning to the blessings of a child conferred on the elders of church and State and later sanctified what was otherwise an unseemly scramble for the Dalai Lama's food as a re-enactment of the ancient ritual of sharing in the flesh of the sacrificial victim.

Relics of the Buddha

BUDDHISM of another order, but nevertheless of a closely related world of thought, appears in the announcement that Buddha relics of exceptional sanctity, discovered in Central India nearly ninety years ago and since in private possession in England, will now return to the East. They have been given to a Buddhist Temple in Ceylon by Mrs. Leslie Smith and Mrs. Winifred Burrows, granddaughters of General F. C. Maisey, by whom they were discovered when with Sir Alexander Cunningham he was investigating the numerous Buddhist monuments around Bhilsa in 1851. The discovery, as described in *The Times* of February 27, consisted of a relic casket—a small crystal tope, with terrace, plinth, hemispherical dome, square pedestal and a double pinnacle, this last forming the stopper of a small perpendicular shaft. This casket has been dated at about 350 B.C. The relic chamber at the bottom of the shaft contained minute pieces of bone, the whole being enclosed in a red earthenware box, which also contained other pieces of bone, and a series of the seven precious things usually accompanying the relics of an eminent person, namely, thin round pieces of gold, a bead of garnet, a crystal bead, two beads of pale greenish crystal, and some minute fragments of pearl.

The casket is now in the India Section of the Victoria and Albert Museum, South Kensington; but a cast and photographs have been supplied by the authorities in order that a replica may be made in Ceylon by native craftsmen. The relics and the seven precious things, which were retained by General Maisey when he presented most of the antiquities to the Museum, have now been enclosed in a carved silver tope from Ceylon for their conveyance to the island.

Sutton Hoo Burial a Cenotaph?

IN an account of the excavation of the Sutton Hoo ship-burial and of the associated antiquities delivered before the Society of Antiquaries of London on February 22 (see NATURE, Feb. 10, p. 231), Mr. C. W Phillips referred to the remarkable feature of the deposit that it did not accompany a body. The explanation which he put forward on certain grounds was that the mound and its contents as a whole had the character of a cenotaph for a great man whose body could not be recovered, possibly through being lost at sea. One suggestion which has been offered, namely that it may have been a measure of insurance on the part of a recently Christianized pagan in an endeavour to make the best of both alternatives, is perhaps not to be taken seriously. Nevertheless survival of a pagan ritual, even in such an essential rite as burial, cannot be ruled out entirely; and it receives a certain amount of support from the archaic character of the ship, of which some further account was given.

The excavation of the ship was under the direction of Lieutenant-Commander J. K. D. Hutchinson of the Science Museum, South Kensington. It proved to be a remarkable vessel in the form of an open barge, clinker-built, keel-less, and propelled by at least thirty-eight oars. It was described as a development of a type already known to archaeologists, and, it may be supposed, of a type already archaic at the time of its burial. In its character as a royal barge, a comparison was instituted with the position of the royal yacht *Victoria and Albert* among contemporary shipping. This view would accord with the interpretation of the find which emphasizes its highly ceremonial nature. At the same time it may be recalled that ship models found by the Danish Thule Expedition to Greenland pointed to Norse ships still being in use of which the essential features had remained unchanged for a period of nearly six hundred years.

Cosmic Rays

THE twenty-fourth Guthrie Lecture of the Physical Society was delivered by Prof. P. M. S. Blackett on February 26. He took as his subject "Cosmic Rays: Recent Developments". He said that the most important discovery of recent years in the field of cosmic rays was the realization that the hard or penetrating component of the rays consists of particles of a new type, called mesotrons. This new particle has a mass intermediate between that of the electron and the proton and possesses the peculiar property of being spontaneously unstable. Its average life when at rest is about one millionth of a second, but when moving fast it lives longer—thus giving a nice verification of Einstein's principle of relativity.

The rays incident on the earth's atmosphere are of very great energy. Recent work shows that some of the rays have an energy certainly as high as one thousand million million volts. This is an astonishingly great energy, and it is probably not the limit. It is quite likely that rays exist with energy as high as a million million million volts or even more. Particles of such great energy have very peculiar properties. Instead of producing a narrow track of ionization a fraction of a millimetre broad like normal atomic tracks, they make a track many metres broad. This is deduced from relativity theory, but has not

yet been verified experimentally. Great interest is attached to the 'spectrum' of the rays incident on the earth's atmosphere, since they should give some light on a possible origin for the rays. It is rather remarkable to find that the spectrum of the rays can be represented roughly by a simple power law over a range of energy of above a million to one. More precisely, the number of rays with energy greater than some given value is roughly inversely proportional to the square of the energy, over the energy range from a thousand million to a thousand million million volts. It can scarcely be doubted that this remarkable law must have some profound, but at present unknown, cosmological significance.

Fuel in Science and Practice

THE monthly periodical *Fuel in Science and Practice* has completed eighteen volumes since it was launched as a supplement to the well-known mining journal *Colliery Guardian*. It was established on the initiative of the Coal Research Club in order to provide a medium of communication for those interested in the scientific study of fuel, and coal in particular. It was the first journal of its kind in the English language and has proved very successful, the success being doubtless due in a large measure to the efforts of its first editor, the late Prof. R. V. Wheeler. The first number of the nineteenth volume has now appeared under the editorship of Dr. R. Lessing, who has been associated with the venture since its inception. This, it may be taken, will ensure continuity of policy. It will continue to aim at providing a clearing-house for the results of investigations and a bridge between the science and practice of fuel technology.

The Institute of Fuel has decided to adopt *Fuel* as its research journal for the benefit of its members who wish to be kept informed of the results of recent investigations into coal and other combustibles. The Coal Research Club, assisted by an editorial committee, will continue to direct its policy and ensure the maintenance of its old and successful traditions. It seems probable that the importance of fuel technology for some years to come will ensure a prosperous future for this journal. At the same time, it is pertinent to recall the unsatisfactory state of the documentation of science. While it appears relatively easy to publish journals containing interesting articles, the thankless task of publishing systematic abstracts is a growing burden the support of which meets steady reluctance.

Coal-Gas and Fuel Research at Leeds

PROF. D. T. A. TOWNEND, who succeeded Prof. J. W. Cobb as head of the Department of Coal-gas and Fuel Industries and Livesey professor in the University of Leeds, has now issued his first report, covering the session 1938–39, to his Advisory Committee. He takes an opportunity therein to pay a tribute to the late Prof. Smithells, who died during the term under review and who was a member of the Committee from the time of its formation. To him also was due, more than to any other man, the formation of the Fuel Department in the University and, a few years later, the establishment of the Livesey chair by subscriptions from the gas industry.

In the body of the report, Prof. Townend reviews in turn the varied activities of his department, which has developed in several directions, not only fuel and gas engineering, but also the cognate subjects of refractory materials and metallurgy, in both of which teaching and research have made much headway. A post-graduate diploma in fuel and refractory materials has been instituted along similar lines to those already given in gas engineering and in fuel and metallurgy. The first opportunity will be taken to give a more systematic course in chemical engineering, which is, in effect, so largely the subject of the departmental teaching. Research continues to be supported by the gas industry and the Iron and Steel Institute. Prof. Townend is continuing work on flame, which had engaged him in London, and independent research work carried out by the staff and students continues to be a marked feature of the departmental activity.

Modern Colour Printing

IN the *Electrical Review* of February 2, an illustrated description is given of some of the new equipment installed by Geo. C. Caster and Co., Ltd., commercial and colour printers, who recently transferred their works to Cromwell Road, Peterborough. In accordance with modern practice the factory has been set out on a single floor, with a planned layout for the speedy handling of work and an uninterrupted continuity of production. There is no shafting, and individual direct electric drive is employed on all machines. One of the large high-speed letterpress machines is a two-revolution Miehle capable of a maximum output of 3,000 sheets, 25 in. by 40 in., per hour. Another large two-revolution machine takes bigger sheets (30 in. by 40 in.) and can print 2,300 sheets per hour. For small sheets up to 13½ in. by 20 in. vertical Miehle machines are brought into service. These are specially suitable for high-class colour printing. A maximum of 4,500 prints an hour can be handled by each machine.

The use of a general lighting system of high intensity throughout the factory makes local lighting unnecessary (except under the machine boards). In the composing room an illumination intensity of 35 ft.-candles at the working plane is obtained with Benjamin reflectors, which are also used in the binding department to provide 10 ft.-candles. To facilitate the matching of ink colours, daylight reflectors have been installed in the machine department to give 14 ft.-candles.

The Achromatic Lens

THE contributions made to *Lychnos* during the last two years by Drs. N. V. E. Nordenmark and J. Nordstrom dealing with the invention of the achromatic lens and the part played by S. Klingenstierna, professor of mathematics at the University of Uppsala, in the process, have been issued as a pamphlet by Almquist and Wiksells, Uppsala, with an English summary. Many of the original documents bearing

on the history of the invention are reproduced with illustrations. One of the most important is Ramsden's Royal Society paper of June 18, 1789, from which it appears that Chester Moor Hall had an achromatic object glass ground for him in 1732 or 1733 and that achromatic telescopes were made for him by the Strand optician J. Bird. The patent for the construction of such lenses from crown and flint glasses was taken out in 1758 by J. Dollond but no calculations were given, probably owing to the desire to keep the theory from other opticians. Klingenstierna worked out the theory, published it in the Transactions of the Swedish Academy in July 1760 and sent a copy to the Royal Society, which published it, although Dollond stated that it contained nothing which he had not done himself previously.

Early Agricultural Tractors

MR. R. H. CLARK, in the *Engineer* of February 2, under the title "Some Early Burrell Engines", recalls an almost forgotten chapter in the development of steam traction engines, built mainly for agricultural work. In 1846, James Boydell took out a patent for his "Endless Railway", and eight years afterwards patented improvements on it. His ideas were taken up by Charles Burrell and Co., a firm of country engineers established at Thetford in 1770, and in 1856 the first road locomotive was constructed embodying the principle of the "Endless Railway". The general arrangement of the traction engine was much as that familiar a few years ago, but each of the wheels, instead of running on the surface of the road or field, ran on a series of flat shoes which in succession were brought into position by links and pins attached to the wheels. There were six shoes to each wheel.

This arrangement of shoes allowed the engine to move over the roughest roads and over soft and marshy ground. One of the illustrations shows an engine drawing four two-furrow ploughs. In 1857 a Boydell engine drew a load of nearly 44 tons from Bury St. Edmunds to Woolwich Arsenal at an average speed of 3·1 miles per hour. The cost of transport was 2*d*. per ton per mile against 6*d*. if horses had been employed. Boydell engines were apparently being built up to 1868, when they were abandoned for engines with ordinary wheels.

Prevention of Diphtheria by Immunization

ABOUT 60,000 cases of diphtheria, chiefly among children less than fifteen years of age, are notified annually in England and Wales, with some 3,000 deaths. Yet it has been shown, particularly in certain cities in Canada and the United States, that by artificial treatment or immunization the disease may be practically banished. The Minister of Health has therefore issued an official memorandum urging that artificial immunization should be undertaken by county councils and sanitary authorities (Memo. 170/Med. H.M. Stationery Office. 1*d*. net). It is suggested that the immunization should be undertaken as early in the child's life as is practicable and should form an integral part of the work of child welfare centres. The Memorandum gives technical details of the procedure and of the various forms of diphtheria prophylactic used, and of the need for Schick testing after treatment to ascertain whether this has been successful.

Lice

THE Minister of Health has recently issued a "Memorandum on the Louse and How to Deal With It" (Memo. 230/Med., 1940). Its publication comes at an opportune moment, when experience of evacuation has brought the louse problem into prominence. In the event of serious air raids large bodies of people may have to be removed to other districts. This, in itself, is liable to cause the spread of lice to localities, or among people, previously free from infestation. Ample powers are available under the Education and Public Health acts for the application of suitable control measures, and it is to be hoped that public medical officers and other officials will do all possible to reduce what has long been a standing menace to proper living conditions. Copies of the memorandum may be purchased directly from H.M. Stationery Office, or through a bookseller, price 2*d*. net.

Vitamin E

REFERENCE was made in NATURE of December 16, 1939, p. 1008, to a solution of vitamin E now available commercially. Glaxo Laboratories Ltd. put on the market in 1933 capsules of wheat-germ oil extract (thirty times as potent in vitamin E as wheat-germ oil itself). The capsules were given the name 'Viteolin' in 1937. Viteolin was the preparation used by Currie and M'Gonigle in their published clinical trials which confirmed in Great Britain the value of vitamin E in the treatment of habitual abortion. With the availability of vitamin E as a chemical substance (tocopherol) each 'Viteolin' capsule has been standardized to contain the vitamin E potency of 6 mgm. of tocopherol, the potency clinically established as the desirable daily dosage.

Institute of Physics and Freedom in Science

THE Institute of Physics has sent the following letter signed by its president, Prof. W. L. Bragg, to the Polish Ambassador: "On behalf of the Board of the Institute of Physics I have to convey to you, and through you to your Government, the deep sorrow with which British physicists at home and overseas have heard of the forcible closure of the Institute of Physics in Warsaw, the dispersal of its eminent staff and the confiscation of its valuable equipment. Our sympathy goes out to our Polish colleagues in this interruption of their labours for the progress of our science, and in the tragic and unmerited hardships and perils which they are enduring. We look forward to the time, which we pray may not be far distant, when, restored to its former freedom, the Institute of Physics in Warsaw shall once again take its place among the great scientific institutions, and continue its work for the advancement of learning, and the welfare of mankind."

British Museum (Natural History)

IT has been decided that the British Museum (Natural History) shall be open to the public every afternoon from 1 until 5 p.m. beginning on February 28, and it is intended after Easter that the Museum shall be open all day from 10 a.m. until 5 p.m. Certain galleries only are available, and the present restrictions will continue to apply to the number of visitors and to the admission of children unaccompanied by adults.

The Department of Botany has received about seven thousand specimens as a result of an expedition to the Outer Hebrides (Lewis and Harris) organized during the past summer by Miss M. S. Campbell. Miss Campbell was accompanied by Dr. J. W. Campbell, Mr. C. V. B. Marquand, and Messrs. A. J. Wilmott, E. B. Bangerter and J. A. Crabbe of the Department of Botany. The collection is fully representative of the summer flora of the areas visited. Dr. R. Scott Russell has returned from a botanical expedition to the Karakorum Himalayas. The expedition, which would otherwise have continued into 1940, was cut short by the outbreak of war and only the collecting planned for 1939 was carried out. The number of gatherings made was 870, and the specimens collected have been left at Kashmir to be forwarded to the Museum later.

Earthquakes in Turkey

ACCORDING to a *Times* message, the final official figures for the Turkish earthquake of December 26 are 32,741 killed and 9,404 injured. It is also reported that it has been decided to rebuild Erzinjan slightly to the north of the old town and that construction is beginning.

Aftershocks of the earthquake still continue with considerable severity. Between 3 a.m. on February 21 and noon on February 24 another 300 people were killed, many more injured, and more than 10,000 head of cattle perished in addition to six villages being completely destroyed. The earthquakes commenced about 3 a.m. on February 21, and before 5 a.m. there had been eight severe shocks. The epicentres appear to have been near the village of Soysalli, near Kayseri in Central Anatolia, some 150 miles south-east of Ankara. Soysalli and three other villages were completely destroyed and the shocks were sufficiently intense to have been felt in eleven districts and many towns, including Ankara, Istanbul, Smyrna, Konya and Adana. On February 22 there were six more shocks and on February 23 and 24 the shocks continued with decreasing severity. In spite of the intense cold which still prevails in this part of Turkey, many people are preferring to live in tents.

Problems of the Industrial Scientist

A CONFERENCE on "The Problems of the Industrial Scientist" convened by the Association of Scientific Workers and the British Association of Chemists, will be held on March 9, commencing at 2 p.m., in the lecture hall of the Pharmaceutical Society, 17 Bloomsbury Square, W.C.1. All scientific workers and others interested are cordially invited to attend and participate. Prof. F. G. Donnan will be in the chair Mr. Hugh Linstead, of the Pharmaceutical Society, will open the proceedings with a general survey of the problems of scientific workers employed in industry. This will be followed by a series of short papers and discussions. At the conclusion of these discussions, Prof. J. D. Bernal will sum up the discussion as a whole, and the conference will then consider the possibility of adopting a 'programme' for scientific workers in industry. Similar conferences are being held at Liverpool, at 6.30 p.m., on March 4, at 5–6 Bluecoat Chambers, Liverpool, 1; Manchester, at 3.0 p.m., on March 16, in the Chemistry Lecture Theatre, the University; Birmingham, date to be announced later. Following the regional conferences, it is intended at a later date to hold a National Conference to review the data and resolutions resulting from them, and to decide on the final form of the 'programme' and on steps to be taken to work for its acceptance. Further information can be obtained from the Secretary, Association of Scientific Workers, 30 Bedford Row, W.C.1.

Announcements

THE British Association is arranging a conference on "Science in National and International Aspects", to be held at Reading during July 24–26. This will take the place of the ordinary annual meeting which would in normal circumstances have been held at Newcastle.

MR. ASA BINNS, until recently chief engineer of the Port of London Authority and now a consultant to the firm of consulting engineers, Messrs. Rendel, Palmer and Tritton, has been elected president of the Institution of Mechanical Engineers for the year 1940.

DR. LOUIS MARTIN, director of the Pasteur Institute of Paris, has succeeded General Sieur as president of the Academy of Medicine of Paris.

THE Council of the Royal College of Surgeons of England has undertaken to organize a library at the medical base in France for the use of the officers of the Royal Army Medical Corps.

THE Oxford Ophthalmological Congress will be held at Oxford on July 4–6. Prof. Le Gros Clark will deliver the Doyne Memorial Lecture, and there will be a discussion on "Emergencies and Complications of the Operation for Cataract".

THE Board of Education has just published a "Handbook of Suggestions of Health Education" (H.M. Stationery Office. 6*d*. net). The book is issued primarily for the benefit of teachers, and covers most aspects of health education, and incorporates recent advances in the science of nutrition.

ERRATUM. Letter by Dr. D. Roaf entitled "Energies of β-Particles from Uranium-X_2" in NATURE of February 10, p. 223, the numbers along the $H\rho$-axis in Fig. 2 should read: 0, 5000, 10,000.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 351. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Radium Treatment

SIR LEONARD HILL returns in NATURE of January 27, p. 151, to his statement "that we would be little the worse off if all the radium now buried in deep holes for security from bombing remained there", and seeks to make good this assertion by reminding us of some of the casualties of radiological practice. He has allowed these examples to stay in the forefront of his mind, instead of fitting them into the groundwork of experience, which every practising radiologist must do.

The dangers attending the use of radium and X-rays have been the concern of the X-ray and Radium Protection Committee for many years. No Committee can possibly safeguard a patient against an unskilful application of rays, but radiologists have striven to limit such dangers by making a real specialty of their subject; and there are at present five universities or kindred bodies in Great Britain which grant medical diplomas in this subject. The subject has, indeed, reached a status where its exponents can afford to ignore the rather baser charges in question, but the dis-service of Sir Leonard is to the public, who pay undue attention to his *ex cathedra* statements.

It is not true that the 15,000 patients (mostly cancer patients) who received radium treatment in Great Britain during the year 1938 had such treatment because of the vested interests of the medical public; the vast majority had radium treatment because it was considered the best available for them. It should be remembered that more than 90 per cent of the country's radium is held by big organizations, such as the Radium Commission, the King's Fund and the Medical Research Council; this is some guarantee that it is used by people of responsibility.

Sir Leonard would like to see "the use of radium or X-rays being reserved for one or two places in the body where surgical operation is very difficult". The publication "Medical Uses of Radium" has been issued yearly since 1922 by the Medical Research Council, and the Radium Commission has in recent years made annual reports on the results of treatment; from them the pertinent fact emerges that the medical profession continues year by year to treat various forms of cancer at many sites of the body, and there is a disposition to widen rather than restrict the field. As for radium in the boreholes, it is only right that the public should know that much of the radium put away for safety has now been brought into use for their treatment.

SIDNEY RUSS.

Barnato Joel Laboratories,
Middlesex Hospital,
London, W.1.
Feb. 6.

SIR LEONARD HILL writes, in NATURE of January 27, with reference to radium treatment and expresses a belief that "we would be little the worse off if all the radium now buried in deep holes for security from bombing remained there. . . ." This pessimism contrasts notably with the enlightened optimism of the article, in the same issue, written by Dr. John H. Lawrence, of the University of California, who is working with great opportunities at present lacking in Great Britain. Lawrence and his co-workers are pursuing "the possibilities of artificial radioactivity and neutron rays in cancer therapy until a more satisfactory answer to this problem has been reached". What we require in Great Britain is a well-organized radiological institute where the various possibilities of radiation can be developed and extended. It had always been my hope and ambition that such an institute would be founded as a memorial to Lord Rutherford, who was always wide awake as to the possibilities of radiotherapy and the proper means by which they could be furthered or achieved.

Sir Leonard Hill has collected a certain amount of gossip about radium and narrates a few cases of failure due to the misuse of radium which have come to his personal notice. To counterbalance his citation of deplorable failure, I could quote instances in my own experience where men with cancer of the throat, and elsewhere, have been treated by radium and returned in full health and happiness to their useful work and daily life.

It is admitted by all that the cause, prevention and cure of cancer have not yet been attained. In some cases, when early treatment has been given, there has been cure or palliation by three chief means, surgery, radium, X-rays. All three methods can be and have been grossly abused in some cases, but wisely applied in a vast number of instances. It is not proposed to abolish railway signals because a signalman has wrecked a train by pulling the wrong switch; the effort is made to improve the arrangement, to make it fool-proof, to have an efficient block system. Surgery is not condemned wholesale because of occasional deaths by incapacity, ignorance or carelessness. There have been deaths from dressings or swabs left in the wound. The wrong gas has been administered as anæsthetic. Overdoses of morphia have been given. A man can cut his throat with a safety razor. All such mistakes are no justification for complete disuse of the means employed.

It is, however, necessary to answer Sir Leonard Hill's ill-timed statement in a more positive sense, always remembering that while surgery has been under the guidance of men of high skill and intelligence for centuries—of men provided with every facility—on the other hand, both radium and X-rays are recent discoveries and naturally their applications to therapy are yet in their infancy.

A system of properly controlled and measured dosage, which can be repeated at will with exactitude, has scarcely yet been fully evolved. Certainly, in the past haphazard applications have produced deplorable results, but these are now avoidable in consequence of the research work already done on the proper direction of the radiation and on the determination of the magnitude of the dosage delivered to the growth and to the surrounding tissues.

Sir Leonard raises the question of the relative merits of radium and of X-rays and settles the matter to his own satisfaction with a positive assertion in favour of X-rays. In no part of the world has this difficult question yet been answered with sufficient scientific evidence to admit of certainty. The same uncertainty prevails as to the rival merits of X-rays of various voltages and wave-lengths. We may conjecture, but we cannot assert. Indeed these two important questions are forming part of an investigation by the Radium Beam Therapy Research under the Medical Research Council, and it is a matter for deep regret that this important work should be temporarily suspended by the exigencies of war.

Some of my well-informed friends point out to me that, in the case of cancer of the uterus, Wertheim's operation for the removal of the whole organ has been given up by surgeons throughout the world and replaced by the use of radium and subsequent wider irradiation with X-rays. This change was largely due to the influence of pioneer work done at the Curie Institute in Paris and Radiumhemmet of Stockholm. In fact, no sooner was the radium placed underground in September than gynæcologists implored that some of it should be made immediately available to save life and relieve distress.

In the case of cancer of the breast, both surgery and radiation are available, and it is a matter of expert advice to decide which is the better in a given case; always insisting on the importance of early and *correct* diagnosis. In carcinoma of the throat, treatment by the radium beam can be used without mutilation or loss of speech, and in cases too advanced for surgery. While surgery may be of some avail with cancer of the rectum and prostate, we have to admit with regret that all methods fail when the œsophagus or stomach is concerned. In less serious cases—such as skin and lip cancer—either surgery or radiation is effective, but most patients would prefer to avoid mutilation and scar by the simple and perfectly safe application of a few milligrams of radium, or its equivalent, for a few hours.

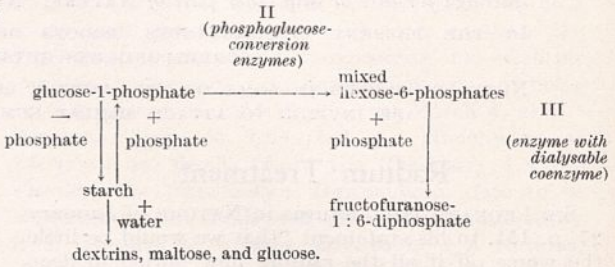
It is scarcely necessary to reply to Sir Leonard Hill's reference to those unfortunate girls, who licking radium paint from their brushes, accumulated radium in their system. Is it suggested that this is in the remotest degree connected with radium therapy? As to the miners' phthisis in the Joachimthal mines, it can unfortunately be matched with closely similar results in the gold mines of South Africa—a matter requiring the closest attention and medical research with a view to prevention and cure.

A. S. EVE.

Overponds Cottage,
Shackleford,
Surrey.
Feb. 5.

Enzymic Synthesis of Starch from Glucose-1-Phosphate

IN an earlier investigation[1] it was shown that pea seeds contain a complex of enzymes which catalyse the following series of reactions, I–IV:



These transformations exhibit a striking parallelism with those associated with the breakdown of glycogen, and its recently reported synthesis from glucose-1-phosphate (Cori-ester), under the action of the enzymes of yeast[2], muscle[3] and liver[4].

In order to study in isolation the reversible reaction I it was necessary to obtain the phosphorylase free from the enzymes which catalyse the alternative reactions II and IV. This was achieved with extracts from pea meal by a process of fractional precipitation with ammonium sulphate.

Meanwhile it has been found that many plants contain phosphorylase, which is present in various organs including leaves, roots and tubers. The potato tuber has proved to be a particularly suitable source. Crude juice pressed from this tissue contains an active phosphorylase but exhibits no phosphoglucose-conversion activity; the weak amylase which is present is completely eliminated, and the phosphorylase is purified, by repeated fractional precipitation with ammonium sulphate.

Using these purified preparations of potato phosphorylase, a detailed study has been made of the reaction:

$$\text{Starch} + \textit{free}\text{-phosphate} \underset{b}{\overset{a}{\rightleftharpoons}} \text{glucose-1-phosphate.}$$

A state of equilibrium is reached, whether the reaction is proceeding in directions *a* or *b*, when the ratio of *free*-phosphate to glucose-1-phosphate attains a value which varies with the concentration of hydrogen ions. Thus in the equilibrium state at *p*H 6·4, 83 per cent of the phosphate exists as free-phosphate and 17 per cent as glucose-1-phosphate, whereas at *p*H 5·4 the proportions are about 90 per cent and 10 per cent respectively.

The equilibrium is not measurably affected by additions of starch even in considerable amounts, suggesting that the *effective* concentration of this reactant is not proportional to its *gross* concentration.

The presence of added starch, however, has a striking effect upon the velocity of the reaction proceeding in direction *b*. Without added starch there is a pronounced induction phase (in both the synthesis of starch and the liberation of *free*-phosphate). The initial velocity is increased by as much as 15-fold, and the induction phase completely abolished, by small additions of starch. This was the case in digests 1 and 2 (shown in Fig. 1), to which 2 mgm. soluble starch per 10 ml. was added initially. Other substances have been found to exert a similar activating effect upon the reaction, maltose being

an example which has been investigated in detail. This phenomenon, which promises to illuminate the mechanism of the catalysis, will be considered fully elsewhere.

Several specimens of synthetic starch, about 20 gm. in all, have now been prepared from glucose-1-phosphate (purified by recrystallization of the potassium salt). The yields of polysaccharide corresponded closely in all cases with those calculated from the amounts of phosphate liberated, and amounted under appropriate conditions to twenty times the weight of dry matter in the enzyme. The principal difficulty in the purification of the synthetic starch has been the removal of protein; thus the precipitates formed on adding trichloroacetic acid or lead acetate contained the bulk of the starch; conversely, the blue-black flocculum formed by the addition of iodine contained much of the protein of the enzyme solution. The reason for this became clear when it was found by microscopic examination that, in advanced stages of the reaction when a marked turbulence develops, the starch is present in the form of small rounded granules which appear to be surrounded by loose floccules of protein; the starch grains are clearly visible whether or not they are stained with iodine (Fig. 2). Under the conditions so far used they attained a maximum diameter of 6–8 μ.

Various observations indicate that the synthetic polysaccharide is closely similar to natural starch. The main discernible difference lies in physical properties, the synthetic material being more resistant to solution and tending to retrograde more rapidly than natural starch of the common relatively large-grained varieties. The following are some of the analytical observations made on purified specimens:

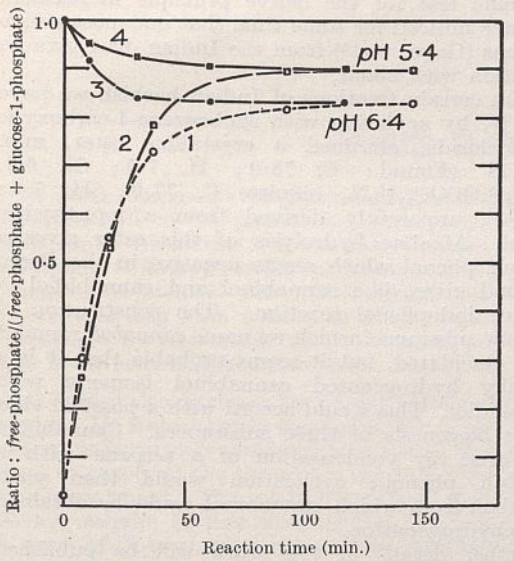
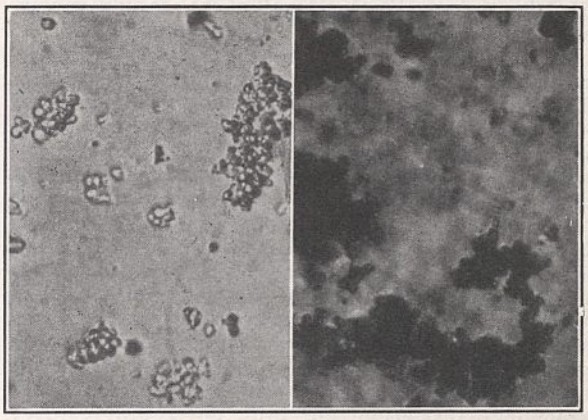


Fig. 1.

CURVES 1 AND 2 SHOW THE PROGRESS OF THE REACTION: GLUCOSE-1-PHOSPHATE → *free*-PHOSPHATE + STARCH, CATALYSED BY PURIFIED POTATO PHOSPHORYLASE; FINAL *p*H VALUES, 6·4 AND 5·4, RESPECTIVELY. CURVES 3 AND 4, AT THE SAME RESPECTIVE *p*H VALUES, SHOW THE REVERSE REACTION. IN DIGESTS 1 AND 2, APPROXIMATELY, *M*/100 GLUCOSE-1-PHOSPHATE WAS ADDED INITIALLY TO THE ENZYME, WHEREAS IN DIGESTS 3 and 4 STARCH WITH *M*/100 INORGANIC PHOSPHATE WAS ADDED.



a *b*

Fig. 2.

PHOTOGRAPHS SHOWING THE GRAIN STRUCTURE OF THE SYNTHETIC STARCH. *a*, UNSTAINED; *b*, WITH DILUTE IODINE. (× 290.)

Rotation—$[\alpha]_D^{20}$ + 200–206° (in water); + 152–159° (in 5 per cent soda); *Reducing power* (by copper reagent)—before hydrolysis, less than 1 per cent the reducing power of glucose; after 2·5 hours in *N*. hydrochloric acid at 100°—equivalent to 99 per cent conversion into glucose; nitrogen—0·05–0·5 per cent; phosphorus—0·05 per cent. In solution it gives a blue colour with iodine with the formation of typical iodine-starch floccules. The iodine-colouring property is rapidly destroyed by the action of the α-malt or salivary amylases.

The full discussion of the above interconversion, in which glucosidic linkages are formed and cleaved with the elimination and addition, respectively, of phosphate will be undertaken elsewhere.

CHARLES S. HANES.
Low Temperature Research Station,
(University of Cambridge and the Department of Scientific and Industrial Research)
Downing Street,
Cambridge.
Jan. 30.

[1] Hanes, *Proc. Roy. Soc.*, B (in the press).
[2] Schäffner and Specht, *Naturwiss.*, **26**, 494 (1939); Kiessling, *Naturwiss.*, **27**, 129 (1939).
[3] Cori, Schmidt and Cori, *Science*, **89**, 464 (1939).
[4] Cori, Cori and Schmidt, *J. Biol. Chem.*, **129**, 629 (1939); Ostern, Herbert and Holmes, *Biochem. J.*, **33**, 1858 (1939).

The Nerve of the Pineal Gland

A BUNDLE of nerve-fibres running upwards from the tip of the pineal gland in some mammals was described by Kolmer and Loewy in 1922[1], and was termed by them the "nervus conarii". However, the existence of this nerve as a constant feature has not hitherto been generally recognized, and its origin and destination remain obscure. It has been described by Pastori[2] as having a terminal relation to the wall of the great vein of Galen (vena magna cerebri). Recently the nerve has been identified and studied in this laboratory in monkey and human material. In both cases it has been traced, in cleared preparations and in serial sections, following an uninterrupted course from the pineal gland along the vein

of Galen to enter the dural wall of the straight venous sinus, where it runs in a subendothelial position.

In the human brain, the nerve passes through a remarkable formation of the arachnoid membrane. This resembles in some degree a greatly enlarged arachnoid granulation (Pacchionian body), measuring, in one specimen, 4·0 mm. in height and 2·5 mm. in width at its base. It projects up from the surface of the adjacent part of the cerebellum into the floor of the straight sinus at the point where this is joined by the vein of Galen, and is here attached to the dura mater. The structure of the granulation is peculiar in that it is filled with a sinusoidal plexus of blood-vessels and several large inter-connecting blood-sinuses. The pial matrix is unusually dense, and the general appearance bears a close resemblance to erectile tissue. The real nature and function of this arachnoid formation are still uncertain, but its structure and disposition suggest strongly that it may play an important part in regulating the venous return from the ventricles of the forebrain through the vein of Galen. In a distended condition, the granulation would bulge up conspicuously into the floor of the straight sinus at its anterior end, in a manner which must presumably impede the venous flow.

The nervus conarii, in traversing the granulation, actually passes through the cavity of one of the blood sinuses, ensheathed here in a fine covering of pial tissue. It then runs directly from the summit of the granulation into the dura mater and, as already noted, turns backwards in the floor of the straight sinus. Its further course has not yet been followed. The direction of conduction in the nerve is not known; the fact that in the monkey it can be traced to a core of neuropil in the centre of the pineal gland, in which are embedded numerous large ganglion cells of an autonomic type, suggests that it may be efferent with regard to the gland. On the other hand, most authorities are now agreed that true nerve cells are not a normal constituent of the human pineal gland. The nerve is accompanied by a small arteriole, but this vessel is considerably smaller than the nerve itself. Finally, it may be noted that neither the monkey nor the human material has provided confirmation for the existence of a ganglion at the tip of the pineal gland, as described by Pastori.

A detailed report of these observations will shortly be published.

W. E. LE GROS CLARK.

Department of Human Anatomy,
University Museum,
Oxford.
Feb. 11.

[1] Kolmer, W., and Loewy, R., *Pflügers Arch.*, **196**, 1 (1922).
[2] Pastori, G., *Zeitschr. d. ges. Neur. u. Psych.*, **117**, 202 (1928).

Cannabidiol and Cannabol, Constituents of *Cannabis indica* Resin

IN a previous publication, Work, Bergel and Todd[1] described a method for the separation of cannabinol from *Cannabis indica* resin (hashish) of Indian origin as its crystalline *p*-nitrobenzoate. In the course of further work on hashish we have been able, through the co-operation of the Home Office (Drugs Branch), to examine a fresh specimen of the Egyptian drug. Application of the *p*-nitrobenzoylation process to the distilled resin from this material yielded a less soluble fraction consisting of cannabinol *p*-nitrobenzoate (in smaller amount than from the Indian drug) mixed with a second ester of much lower melting point. The latter was very difficult to separate and purify; the free phenol obtained from it by hydrolysis was a yellowish resin which, in contradistinction to cannabinol, gave a positive Beam test (purple colour with alcoholic potassium hydroxide).

Adams, Hunt, and Clark[2] have recently described the isolation from American hemp resin of a substance, cannabidiol, yielding a *bis*-3 : 5-dinitrobenzoate, m.p. 106–107° ($[\alpha]_D^{27°} = -76°$). The similarity in colour reactions of cannabidiol and the above substance from the Egyptian resin was immediately evident, and conversion of the latter to its *bis*-3 : 5-dinitrobenzoate gave an ester m.p. 106–107° of which the analysis and optical rotation ($[\alpha]_D^{13°} = -76·2°$) also agreed with those of the cannabidiol derivative; there can be little doubt as to the identity of the two compounds. The molecular formulæ of cannabinol $C_{21}H_{26}O_2$ and cannabidiol $C_{21}H_{30-32}O_2$, together with their simultaneous occurrence in hemp resin, suggest a structural relationship between the two compounds, and preliminary chemical investigation seems to bear this out[2]. It would seem that, as regards these constituents, Egyptian hemp resin occupies a position intermediate between American resin, in which cannabinol seems absent, and Indian resin, from which cannabidiol has not yet been isolated, although it may be present in small amount.

The physiological inactivity of cannabidiol lends further colour to the view that the Beam test is not a specific test for the active principle in hashish. We have noticed for some time that our most active fractions (Gayer test[3]) from the Indian drug give no coloration with alkali.

From certain fractions of Indian hashish we have recently, by acylation with azobenzene-4-carboxylic acid chloride, obtained a crystalline ester, m.p. 117–118° (Found: C, 78·0; H, 7·5; N, 6·1. $C_{21}H_{31}O.OCOC_{12}H_9N_2$ requires C, 77·9; H, 7·6; N, 5·4), apparently derived from a monohydric phenol. Alkaline hydrolysis of this ester gives a resinous phenol which reacts negative in the Beam test and gives, like cannabinol and cannabidiol, a positive indophenol reaction. The constitution of this new substance, which we name *cannabol*, remains to be elucidated, but it seems probable that it is a partially hydrogenated cannabinol isomeric with cannabidiol. This would accord with a possible view of the biogenesis of these substances. Cannabidiol may arise by condensation of a terpene with a dihydric phenol; cyclization would then yield cannabol, from which cannabinol could be obtained by dehydrogenation.

Further details of this work will be published elsewhere.

A. JACOB.
A. R. TODD.

The University,
Manchester.
Feb. 6.

[1] *Biochem. J.*, **33**, 123 (1939).
[2] *J. Amer. Chem. Soc.*, **62**, 196 (1940).
[3] *Arch. Exp. Path. Pharm.*, **129**, 312 (1928).

Polyploidy in *Rumex acetosella* L.

THE species *Rumex acetosella* L. is a weed, which seems to be distributed all over the northern hemisphere. It has been investigated cytologically by Roth[1], who counted the chromosome number $n = 16$ ($2n = 32$), and later, among others, by Meurman[2], Kihara[3], and Jensen[4], who all found the number to be hexaploid or $2n = 42$.

Last summer I examined material of *Rumex acetosella* and its varieties from Sweden and Iceland. In the main species, having rather broad leaves, I also found the hexaploid number $2n = 42$, both in the male and the female individuals. However, in plants belonging to the variety *tenuifolius* A. and Gr. (Ascherson and Graebner[5]), the number proved to be $2n = 28$, or tetraploid. This number was not known before in *Rumex acetosella*, according to Tischler[6].

The leaves of the tetraploids are narrower than those of the hexaploid forms. In other details the tetraploid variety is also smaller than the main type, and most often shows a prostrate mode of growth. Both the tetraploids and hexaploids are quite normal sexually, and they also seem to have different geographical distribution.

ASKELL LÖVE.

Institute of Genetics,
Lund, Sweden.
Feb. 14.

[1] Roth, F., *Verh. d. nat.-hist. Vereins d. preuss. Rheinl. u. Westf.*, **63** (1906).
[2] Meurman, O., *Sci. Soc. Fenn.* (Biol.), **1** (1925).
[3] Kihara, H., *Bot. Mag. Tokyo*, **39**, 353–360 (1925); *Jahrb. wiss. Bot.*, **66**, 442–460 (1927); *Jap. J. Genet.*, **4**, 90–101 (1929).
[4] Jensen, H., *Cytologia*, **7**, 23–34 (1936).
[5] Ascherson, P., and Graebner, P., "Synops. d. Mitteleur. Flor.", **4** (1908–13).
[6] Tischler, *Tabulæ Biologicæ*, **4** (1926), **7** (1931), **11–12** (1935), **16** (1938).

Occurrence of Bismuthinite in Somerset

AT the end of July last year, while examining the material on the waste-heaps of the Langham Hill Mine, one of the group on the Brendon Hills, Somerset, which was worked for iron during the middle and latter half of last century, I noticed small stains and patches of malachite on some of the crystalline chalybite at one end of the main dump. A number of these pieces were collected and, on being broken open, were found to contain small amounts of chalcopyrite, bornite, and occasionally chalcocite, while a few had, in addition, thin veins and patches of a steel-grey metallic mineral scattered through them, in some cases closely intergrown with the copper minerals.

Blowpipe tests on this steel-grey material showed the presence of copper and bismuth, and from its association with the other copper compounds, it was at first taken as possibly being tetrahedrite; recent chemical and X-ray examination, however, by Mr. F. A. Bannister, of the Mineral Department of the British Museum (Natural History), has proved it to be bismuthinite (Bi_2S_3).

The presence of small amounts of copper minerals at one or two of these mines has been previously noted and mentioned, but there is no record of bismuthinite being found on the Brendons before, and it is a somewhat unexpected mineral to come across in this particular district, or, in fact, in Somerset as a whole.

ARTHUR W. G. KINGSBURY.

Cumberland Lodge,
Bathwick Hill,
Bath.
Feb. 4.

Points from Foregoing Letters

S. RUSS comments on recent statements by Sir Leonard Hill on the present-day position of radium treatment. He affirms it is not true that this form of treatment is largely carried on because of the vested interests of medical men; the reason for 15,000 patients having been treated in 1938 is that it was considered by responsible medical opinion to be the best treatment available for them.

A. S. Eve also discusses Sir Leonard Hill's communication. He states that in cases of cancer of the uterus radium is frequently preferred to surgery. Inoperable cases of cancer of the throat are improved by radium beam treatment. The relative merits of radium and X-rays require further investigation, and the same is true of X-rays of various wave-lengths. Great Britain requires a radiological institute for the development and investigation of radiation treatment. In the meantime surgery, radium, X-rays all have their spheres of usefulness which overlap one another.

C. S. Hanes reports the occurrence in various higher plants of an enzyme which catalyses the reversible conversion of starch into glucose-1-phosphate. The effect of different factors upon the equilibrium is discussed, together with observations on the properties of specimens of starch synthesized from pure glucose-1-phosphate by the action of this enzyme. A fact of considerable botanical interest is that the synthetic starch is deposited in the form of well-formed grains.

W. E. Le Gros Clark states that the nerve of the pineal gland (nervus conarii) has been identified in human and monkey material. It runs an uninterrupted course from the tip of the pineal gland into the dura mater of the tentorium cerebelli, and then extends backwards in the floor of the straight venous sinus. On its way the nerve traverses a large arachnoid granulation the structure of which is peculiar in that it contains a plexus of sinusoidal blood-vessels. From the position of this granulation it is surmised that it may play an important part in regulating the venous return from the brain through the great vein of Galen.

The isolation of cannabidiol from Egyptian hashish is reported by A. Jacob and A. R. Todd, who find that in respect of its content of this substance and cannabinol the Egyptian drug is intermediate between the American and Indian varieties. A new compound *cannabol*, which is probably a partially hydrogenated cannabinol, has been obtained from Indian hashish.

RESEARCH ITEMS

Bronzes from Southern Nigeria

A REMARKABLE collection of bronze castings found at Igbo, Southern Nigeria, is figured and described by J. O. Field, assistant district officer, in *Man* of January 1940. They were unearthed in the course of digging a well, but no details are available. The castings would seem to have been made by the *cire perdue* process, though rubber latex may have been used instead of wax. The castings are covered with a rich green patina. The finest piece is an urn or cauldron 10½ inches high with a diameter across the top of 8 inches. It forms a shallow bowl with broad lip on a wide hollow stand. It is decorated with a series of rosettes interspaced with beetles and grasshoppers. At top and base are bands of hatched triangles and in the middle a broad band with a complicated design of rectilinear figures and circles. The edge of the lip and the base are decorated with a twisted cord design. Among other objects are two scabbards in which are the remains of iron blades, but without hilts, a bust with evidence of bead ornament, small shells which rotate, a human head, possibly female, showing cicatrization resembling the modern style, two highly conventionalized rams' heads, with highly ornate twisted horns and three spiral objects, of which two display a snake *motif*, while another peculiar object is a massive casting elaborately ornamented with eyelets, loops and whorls, and also extensively ornamented with coloured beads, and near the top a series of rings from which emerge small snakes' heads, having above them a wheel-like flange with a great number of triangular spokes and on top of this a wide metal ring. The occurrence of an 'Aro knot' suggests contact with the Aro people, but the earliest tradition of their presence in the region does not go back beyond about the middle of the last century. Otherwise there is nothing to determine the origin of this metal work. The Igbo people are not themselves metal workers, and it is improbable that they were made by Benin craftsmen.

Canoe-making in Ancient Hawaii

A TREATISE on the canoe-making profession of ancient times, of native authorship but undated, found among the archives of the Bernice P. Bishop Museum, Honolulu, has been translated and edited by Kenneth P. Emory and Mary Pukui (*Occasional Papers, Bernice P. Bishop Mus.*, **15**; 1939). The writer opens with the statement that the profession was much practised in Hawaii to provide the canoes for fishing, for war and for voyaging from island to island, the experts who built them being much honoured and favourites of the chiefs. There were classes of experts under the classes of royal builders, such as the experts of the supreme ruler, of the ruling chiefs, of the district chiefs, and so forth. Of the timbers used, the koa (*Acacia koa*) was the best. All the forests were occupied by experts for making canoes. The adzes used were of stone. Their making was a laborious task, in which the various operations, chipping, grinding, lashing, were each done by different specialists. Different adzes were used for the various operations—chopping, hewing, hollowing. The canoe-makers were supplied with ancestral gods, who helped in the hewing and hauling. They were both male and female. The canoe-makers were also provided with offerings. If the canoe belonged to a chief these offerings were a hog, red fish, clothing, coconuts and awa. The hog was cooked at the place where the koa tree was to be found. The ancestral gods partook after an invocation, and then all the priests present partook of their portion. The cutting of the tree then began, the priests cutting in pairs. A little bird signified whether the tree would be good or the reverse. The canoe of a chief was hauled to the shore by the people after a feast. Felling the path of the canoe was the last thing to be done. If a new canoe was first taken on a fishing trip, the first fish caught was brought back and offered to the ancestral gods.

Birds of Newfoundland and Colour Modification

SURPRISINGLY little is known of the birds of eastern Newfoundland, and accordingly brief explorations made by David C. Nutt while a member of the Robert A. Bartlett Greenland Expeditions of 1937, 1938 and 1939, have added considerably to the knowledge of distribution, abundance and geographic variation. The results, by John W. Aldrich and David C. Nutt, have recently been published (*Sci. Pub. Cleveland Museum Nat. Hist.*, **4**, 13; 1939). From a general point of view, the most striking result is the discovery that where geographic variation has taken place among resident birds it is shown in a marked darkening of the plumage. This was found, for example, in birds so different as a creeper, *Certhia familiaris*, robin, *Turdus migratorius nigrideus*, "the most deeply coloured of all the American robins", warbler, *Dendroica breviunguis*, water-thrush, *Seiurus n. noveboracensis*, crossbill, *Loxia l. leucoptera*, and others. A similar darkness of plumage was noted in 1919 by G. K. Noble in birds from the western part of the island, but in the east the deepening of colour is even more marked, and confirms Noble's opinion that Newfoundland is a region where the differentiation of dark coloured races is beginning to take place. It may be associated, as is probably also the case in the outer islands of Scotland, with the exceptional humidity of the region.

Transpiration into a Saturated Atmosphere

H. H. Dixon and J. S. Barlee have recently published a paper describing further experiments on transpiration into a saturated atmosphere (*Sci. Proc. Roy. Dub. Soc.*, 22, No. 20, 211; Feb. 1940). A potometer method for comparing the rates of transpiration in gases supersaturated with water is described, and it is shown that replacement of air with nitrogen around the leaves depresses and ultimately inhibits the upward movement of water in a stem. Renewal of the air restores transpiration. Anæsthetization with chloroform reduces or stops the movement; and at least temporary recovery may be attained by surrounding the leaves with supersaturated air. If the supply of supersaturated nitrogen or chloroform is prolonged, reversal of the upward current is produced, and the shoot behaves like a dead system and the water condensing on the leaves flows downwards in the stem.

Inheritance of Inability to Sweat

L. C. Glass and Darrell H. Yost (*J. Hered.*, **30**, 477–478; 1940) report the inheritance of the inability to sweat. The affected individuals show distress at above 85° F., are subject to severe headaches and stomach trouble. The pedigrees suggest that the character is either inherited as a monogenic recessive or on a multiple factor basis. Not only is there an absence of sweat glands in the skin, but also other anomalies of skin development are present.

Sweet Potato Breeding

THE sweet potato rarely flowers or sets seed under field conditions in Louisiana. J. C. Miller (*J. Hered.*, **30**, 485–492; 1940) reports useful methods for the induction of flowers and seed under these conditions. By staking the plants, three varieties were induced to flower, while girdling trebled the number of flowers and also induced earlier flowering. Seed setting was considerably increased by keeping a flowering branch in a water solution of artificial fertilizers in a house.

Cytological Investigations in Allium

S. W. MENSINKAI reports on the chromosomes of seventeen species of Allium, fifteen of which had not been previously reported. *A. sativum*, and *A. Cepa* ($2n=16$) are taken to be secondarily balanced diploids since they possess two pairs of nucleolar chromosomes and two pairs of nucleoli. Univalents were observed at meiosis in *A. Cepa*, *A. Sewerzowii*, *A. nigrum*, *A. scorzonerœfolium* (all diploids) and *A Bidwelliœ* (tetraploid). The individuals examined of *A. Cepa*, *A. Sewerzowii*, *A. cilicum*, *A. scorzonerœfolium*, *A. nigrum* and *A. Bidwelliœ* were inversion heterozygotes.

Wound Hormones of Plants

MANY plant tissue extracts are capable of inducing renewed growth activity in mature plant cells. These growth-inducing extracts are usually obtained from ground or heated tissues and are capable of evoking cell division and cell enlargement in unwounded cells. The active principles have been referred to as wound hormones by Haberlandt. J. English, J. Bonner and A. J. Haagen-Smit (*J. Amer. Chem. Soc.*, **61**, 3434; 1939) find that the crystalline substance isolated from string bean pods and capable of inducing renewed cell division and cell extension activity in the parenchymatous cells of the bean pod is 1-decene-1,10-dicarboxylic acid (which they propose to call 'traumatic acid'), which was also synthesized. This is capable of inducing wound periderm formation in washed disks of potato tuber and to function thus as a wound hormone. Traumatic acid is also capable of partially replacing the juice of the tomato fruit in reversibly inhibiting the germination of tomato seeds.

Synthesis of Vitamin K_1

L. F. FIESER (*J. Amer. Chem. Soc.*, **61**, 3467; 1939) has found that synthetic 2-methyl-3-phytyl-1,4-naphthoquinone is identical with natural vitamin K_1 by a direct comparison of samples with regard to analysis, spectrum, anti-hæmorrhagic activity, colour reaction, and the melting point and mixed melting point of a crystalline derivative. This confirms the conclusion reached by Doisy and co-workers from degradative experiments (*ibid.*, **61**, 2558; 1939) and from a further synthesis (*J. Biol. Chem.*, **130**, 433; 1939), published after the present work was completed. The synthesis was essentially a one-step process utilizing 2-methyl-1,4-naphthohydroquinone and phytol, and provides a method of preparing the vitamin in quantity. By separating and purifying the product in the reduced form prior to oxidation, the quinone is obtained in a pure condition without recourse to distillation or adsorption. Natural vitamin K_1 can be isolated very easily from alfalfa concentrates by a similar procedure. Vitamin K_1 yields phthiocol on cleavage with alcoholic alkali.

Oxidation with Lead Tetra-acetate

IT is known that the cleavage of the carbon chain in compounds containing two and three adjacent hydroxyl groups can be carried out with lead tetra-acetate in aqueous as well as in non-aqueous solution. J. M. Grosheintz (*J. Amer. Chem. Soc.*, **61**, 3379; 1939) finds that the cleavage of the carbon chain of a number of glycosides with lead tetra-acetate is parallel to that known to be produced with periodic acid. The oxidative changes of alpha- and beta-methyl-*l*-arabinopyranosides can be carried out quantitatively in aqueous solution. Contrary to previous experience, three molecules of lead tetra-acetate instead of two were required to complete this reaction, and the reason was found to be the oxidation to carbon dioxide of one molecule of formic acid formed during the first reaction. This reaction does not occur in dry organic solvents or in oxidation in aqueous solution by means of periodic acid, and the formic acid may be oxidized in its ortho-form.

Photometry of the Solar *D* Lines

ALTHOUGH the *D* lines have been measured several times previously, there has always been some doubt about the instrumental corrections, more especially for the central intensity. In a recent paper (*Mon. Not. Roy. Astro. Soc.*, **100**, 1; November 1939), C. W. Allen gives the results of his measurements, corrections derived from a comparison with terrestrial water-vapour lines having been used. The sun telescope and three-prism spectrograph of the Commonwealth Solar Observatory were utilized for the solar spectra of the *D* region. Plates were taken of both centre and limb of the sun near midday, and others were exposed for a few minutes after sunrise to ensure strong water-vapour lines. The results for the central intensities and equivalent breadths are in good agreement with his observations made some five years ago, but the central intensities are much smaller than Houtgast's results published in 1938. The discrepancies are due to the fact that Houtgast made no corrections for finite resolving power.

An Altazimuth Mounting for Reflecting Telescopes

THE REV. W. REES WRIGHT has described a useful wooden mounting to carry a 9-inch reflector which he has manufactured himself (*J. Brit. Astro. Assoc.*, **50**, 3; 1940). The base of the stand is merely a stout three-legged stool, each leg being 30 in. long and 3 in. by 2 in. in section. The top consists of two thicknesses of 1-in. wood, screwed together with the grain crossing, and twelve ball-casters are screwed to the upper piece so as to form a circular bearing for the head. It is possible to raise or lower these casters slightly to make certain that all bear on the head in all positions. Many other details are given which can be easily followed by amateurs, who are recommended to study the description with the diagram if they require a cheap and efficient mounting for a small reflector.

FLORAL ANATOMY OF THE OLEACEÆ

BY PROF. A. C. JOSHI AND A. N. FOTIDAR,
BENARES HINDU UNIVERSITY

A STUDY of the floral anatomy of the Oleaceæ, including *Jasminum pubescens*, *J. Sambac*, *J. auriculatum*, *J. arborescens*, *J. grandiflorum*, *J. humile*, *Nyctanthes arbortristis*, *Olea cuspidata*, *O. fragrans*, *Syringa vulgaris*, *S. emodi* and Ligustrum spp., has brought to light many interesting facts, particularly with regard to the anatomy of the pedicel in Jasminum species and the vascular supply of the ovule. As the full work will take still some time to be completed, the more important observations made so far are recorded here.

The pedicel has normal structure in Olea, Syringa and Ligustrum. Even in *Nyctanthes arbortristis*, where the vegetative stem is characterized by the presence of four inversely orientated cortical bundles[1], the cortical bundles gradually disappear in the floral axis and it has a normal structure. In Jasminum species, however, the condition is very different. In *J. auriculatum*, *J. humile* and *J. arborescens*, the pedicel has normal structure, but in others the pedicel shows, besides the normal vascular ring, many additional bundles in the pith, even though the structure of the vegetative stem is quite normal. Thus in *J. pubescens*, we find that the pedicel just at its base shows only one ring of vascular bundles, but as we proceed upwards, two or three bundles of phloem make their appearance in the pith. Higher up, the number of such bundles increases and they develop both xylem and phloem, so that a transverse section of the pedicel shows many medullary bundles irregularly scattered inside the normal ring (Fig. 1). The structure of these bundles is very variable. They may be collateral, normally or inversely orientated, bicollateral, concentric with phloem in the centre, or may consist of phloem alone. As the calyx-traces begin to pass out, we often find the medullary bundles to show a more regular arrangement. They tend to form a ring of mostly inversely orientated collateral bundles to the inside of the normal ring (Fig. 2). This condition resembles to a certain extent the structure of the stem in certain species of Rumex belonging to the section Lapathum[2], or the structure of the stem of many Cucurbitaceæ[3] and other families possessing medullary phloem. At a still higher level in the thalamus of *Jasminum pubescens*, the medullary bundles gradually pass out and disappear, merging into the bundles of the normal ring. In a large-flowered variety, however, it was observed that all the medullary bundles ultimately fuse in the centre and give rise to a prominent concentric bundle in the centre of the thalamus stele (Fig. 3), which divides again into about four branches that fuse with the ventral traces of the carpels. The pedicel in *J. grandiflorum* shows structure very similar to that of *J. pubescens*, but the medullary bundles are still better

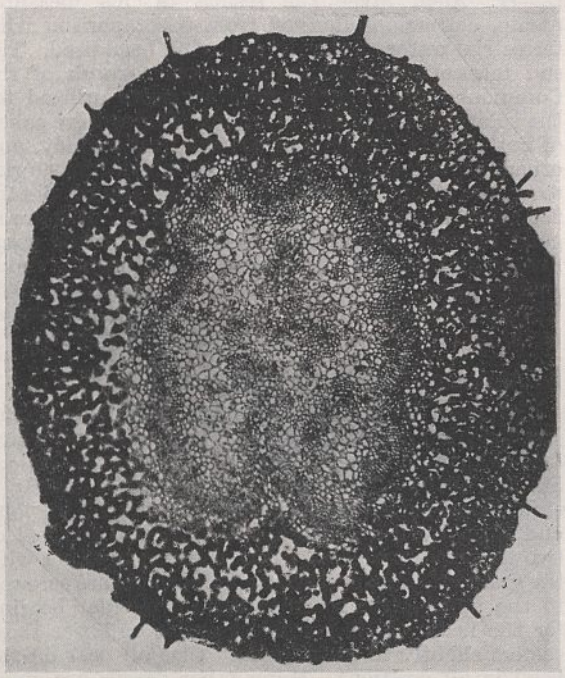


Fig. 1.

Jasminum pubescens. TRANSVERSE SECTION OF THE PEDICEL SHOWING IRREGULARLY SCATTERED MEDULLARY BUNDLES.

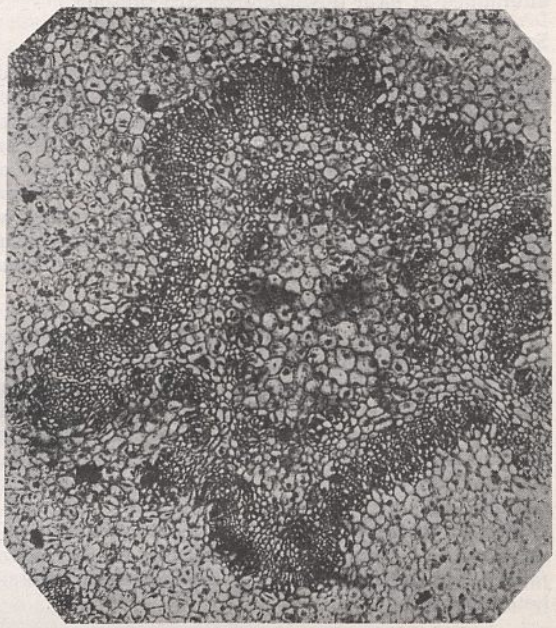


Fig. 2.

Jasminum pubescens. TRANSVERSE SECTION OF THE THALAMUS ABOUT THE LEVEL OF THE ORIGIN OF THE CALYX-TRACES SHOWING A REGULAR RING OF MEDULLARY BUNDLES INSIDE THE NORMAL RING.

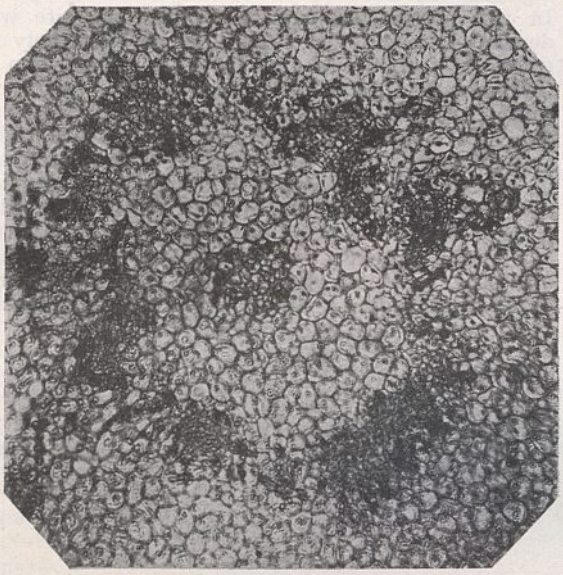


Fig. 3.

Jasminum pubescens, LARGE-FLOWERED VARIETY. TRANSVERSE SECTION OF THE THALAMUS JUST BELOW THE OVARY SHOWING A CONCENTRIC MEDULLARY BUNDLE IN THE CENTRE OF THE NORMAL STELE.

developed. The pedicel in *J. Sambac* also shows medullary bundles, but here their number is comparatively smaller and they consist mostly of phloem alone (Fig. 4). Their structure, however, is essentially concentric, the phloem being surrounded by a cambial ring which forms new phloem elements towards the inside and occasionally some xylem towards the outside.

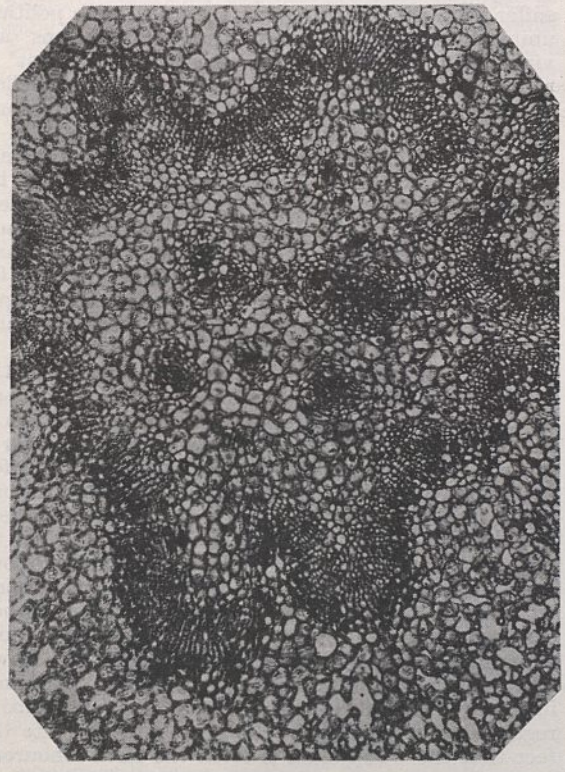


Fig. 4.

Jasminum Sambac. TRANSVERSE SECTION OF THE PEDICEL NEAR ITS DISTAL END SHOWING MEDULLARY BUNDLES OF PHLOEM SURROUNDED BY CAMBIUM.

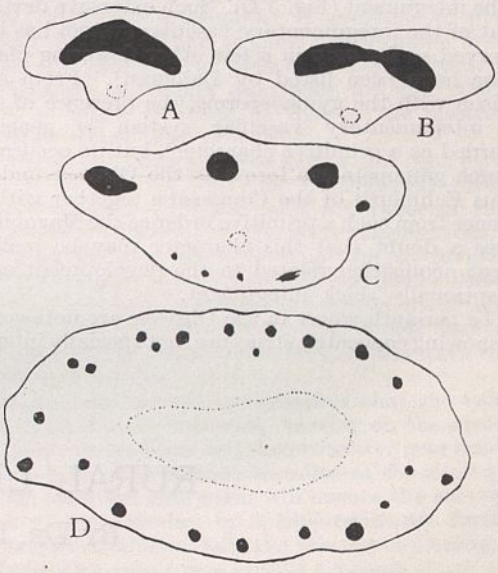


Fig. 5.

A–D. Nyctanthes arbortristis. TRANSVERSE SECTIONS OF AN OVULE FROM THE FUNICLE (*A*) TOWARDS THE MIDDLE (*D*).

The ovules of Syringa, Olea and Ligustrum species possess normal vascular supply. They receive a single bundle which runs up the raphe unbranched and ends in the chalaza. But in Jasminum and

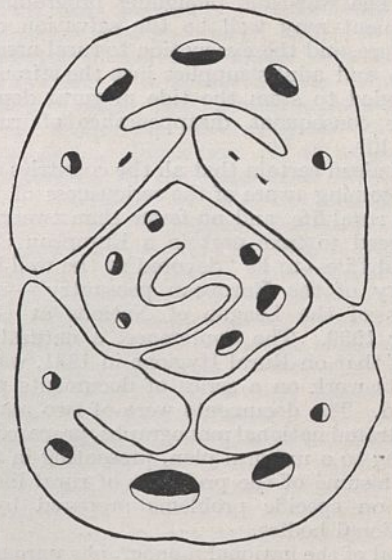


Fig. 6.

Olea fragrans. TRANSVERSE SECTION OF THE GYNŒCIUM SHOWING TWO DECUSSATE WHORLS OF OPEN CARPELS. THE OUTER CARPELS BEAR OVULES ALONG THEIR MARGIN. THE INNER CARPELS HAVE NOT YET COMPLETELY SEPARATED FROM ONE ANOTHER. AN OVULE IS SEEN ARISING FROM THE MARGIN OF ONE OF THEM.

Nyctanthes, the crescent-shaped ovular trace (Fig. 5*A*) soon after its entrance into the funicle divides into two bundles (Fig. 5 *B*). These bundles repeat the division and some of the branches pass to the opposite side (Fig. 5 *C*). These branches divide further, so that the ovule shows about its middle 25–30 bundles in the integument (Fig. 5 *D*). Such extensive development of the integumentary vascular system has been observed so far only in a few other flowering plants. These have been listed by Dahlgren[4]. From comparison with the gymnosperms, the presence of such an integumentary vascular system is generally regarded as a primitive character[5], but its occurrence in such gamopetalous forms as the Oleaceæ and the genus Echinops[4] of the Compositæ together with its absence from such a primitive order as the Magnoliales raises a doubt that this character may be really a recent acquisition related to the development of an exceptionally thick integument.

The perianth traces in the Oleaceæ are noteworthy for showing concentric structure, but specially interesting is the vascular supply of the calyx in *Olea fragrans*. In this species, although the calyx is quite well developed, in many flowers there are absolutely no traces for the four sepals. In other flowers, two or three weak sepal traces are given out, but these disappear in the thalamus itself and never reach the sepals. The calyx is thus quite non-vascular. This supports Mrs. Arber's[6] view that the vascular tissue is in no way more conservative than the organ it supplies.

The gynœcium of *Olea fragrans*, a cultivated garden shrub which does not set seed, consists of two whorls of opposite and decussate open carpels bearing ovules along their margins (Fig. 6). This abnormal structure of the gynœcium is the normal feature of this species in the material at our disposal.

[1] Fotidar, A. N., *J. Ind. Bot. Soc.*, **18** (1939).
[2] Joshi, A. C., *Amer. J. Bot.*, **23** (1936).
[3] Holroyd, H., *Bot. Gaz.*, **78** (1924).
[4] Dahlgren, K. V. O., *Svensk Bot. Tidsk.*, **18** (1924).
[5] Wettstein, R. v., "Handbuch der systematischen Botanik" (1935).
[6] Arber, A., *New Phytol.*, **32** (1933).

RURAL LIFE IN EUROPE

By Dr. L. Dudley Stamp

IT is one of the inevitable consequences of war that the steady march of social progress is interrupted by the more urgent problems of the moment. In Britain, for example, the great work of slum clearance and rehousing has been temporarily suspended, and it is actually possible in the lull to take stock of what has been achieved in the past twenty years. On the other hand, reforms which might have been delayed indefinitely may be rushed through if they have an important bearing on the prosecution of the War. The war-time ploughing programme of the Government may well be the salvation of British agriculture, and the evacuation to rural areas of both children and adults supplies just the stimulus which was needed to stem the tide of rural depopulation and the consequent disappearance of rural community life.

It is indeed certain that all the countries of Europe were becoming aware of the seriousness of the problems of rural life, and no fewer than twenty nations had agreed to take part in a European Conference on Rural Life—to be "devoted to the well-being and solidarity of the European peasantry"—under the auspices of the League of Nations at Geneva in October 1939. The Conference, a natural development of that on Rural Hygiene in 1931, was to have based its work on a series of documents previously prepared. The documents were of two main types: (*a*) illustrated national monographs, prepared officially according to a uniform plan, presenting in attractive style a résumé of the problems of rural life, and (*b*) studies on specific problems prepared by various international bodies.

Several of the national monographs were published[1] —including those for Belgium, Finland, Latvia, Lithuania and Netherlands—and form handy summaries covering the organization of rural life and occupations, including education, medico-social policy and nutrition.

Of the second group of pamphlets, the International Labour Office prepared one on recreation in rural areas and one on sickness and insurance; the International Institute of Intellectual Co-operation one on intellectual aspects of rural life, and the Health Committee of the League of Nations a general survey of medico-social policy. These surveys[2] suffer from the difficulty that they deal with political units so utterly different that comparisons are virtually impossible. The very word 'peasant' is rarely if ever applied to the English country dweller, and the problems here are obviously very different from those in eastern Europe. Nevertheless, it is remarkable that certain fundamental difficulties are apparent throughout—and outstanding is the inadequacy of rural housing. Cramped, overcrowded, ill-planned houses, frequently with antiquated sanitary arrangements, no piped water supply and lacking electric light not only affect health (for example, tuberculosis) but also prevent the proper use of leisure and opportunities for recreation and education which are otherwise available.

Rural housing is, after all, only one result of the fundamental economic position. A few years ago Lord Stamp[3] summed up the whole problem in a single sentence: "the world as a whole and over a given length of time has almost certainly been fed below cost-price for the last hundred years, if one takes into account the proper elements of costs". The more advanced nations are often the last to recognize that the rural countryside needs above everything money. Britain is certainly no exception; with the drift to the towns from the impoverished country areas Britain has become more and more urban-minded as well as urban-dwelling. The Town and Country Planning Acts only conceive 'planning' in terms of urban expansion, whilst slum-clearance is regarded as a problem of the great cities despite the fact that the worst slum is often the farm labourer's cottage.

[1] Allen and Unwin, 40 Museum Street, London, W.C.1. 1*s*. 6*d*. each.
[2] Allen and Unwin, 9*d*. and 1*s*. each.
[3] "World Agriculture: an International Survey", 1932.

PRACTICAL ASPECTS OF EARTHING

IN a paper contributed by Messrs. E. Fawssett, H. W. Grimmett, G. F. Shotter, and H. G. Taylor, to the Institution of Electrical Engineers on February 14, a very thorough discussion is given of the practical aspects of earthing.

The practice of earthing is as old as that of electrical engineering; in fact it is older, as it dates back to the days when electricity was only a scientific study which scarcely interested the engineer. Earthing was then effected by touching the charged body with the finger, whereupon the charge leaked to earth. From then the practice has passed through many phases, though customs die hard, as shown by the 1937 report of electrical accidents in factories and workshops, which states that "another instance was found where the end of the earthed wire was put into a bucket of water, the bucket being specially purchased for the purpose and usually placed on a piece of wood 'to avoid leakage'".

At the other extreme, and typifying the very latest practice, may be cited the proposal to install eight 32 ft. × ½ in. diameter copper rods at a Central Electricity Board substation to secure a resistance of less than one ohm, in soil having a resistivity near the surface of 15,000 ohm-cm. Before 1914 such a resistance would not have been obtained in such soil; in more recent times it might have been obtained, but at a cost at least several times greater than is required to-day; it is now a relatively simple matter. Earthing practice is a good example of the well-known fact that until a quantity can be measured and expressed numerically knowledge is restricted and improvement is slow. For this reason great credit is due to those firms which have produced simple forms of earth-testers which can be used as readily as an insulation-tester. By their use engineers have realized in some measure the limitations of methods of earthing which had been used for many years, they have realized the important effect of the resistivity of the soil, and finally they have found by a few tests that some methods of earthing are far more economical than others.

American engineers profited by a comprehensive publication on earthing issued by the Bureau of Standards in 1918. The recommendations of this report, which are still quoted, were well in advance of British practice at the time, though much has been done to make up the leeway during the last few years. Driven electrodes are now being widely used, and in two important fields, namely, voltage gradients on the ground surface around electrodes and current loading capacity of electrodes, the principal progress has been made in Britain. Research by the Electrical Research Association (E.R.A.) has also shown how the earth resistance of overhead-line towers may be measured without disconnecting the earth wire—a problem in measurement the solution of which is actually of greater importance in other countries than in Great Britain.

All the information necessary to design electrodes economically on a resistance basis is now available and is being used to an appreciable extent. All the research work also that is necessary that has been done on the problem of voltage gradient is available, though it is not as widely known as it should be. The loading capacity problem is still under examination; sufficient information is available to provide a lead in all soils and to give a good guide in clay; when this problem has been completely solved, it will be possible to design electrodes for any condition with as much precision as that of the electric appliances which they protect.

For several years past the E.R.A. has been carrying out investigations into the fundamental problems connected with earthing, and a number of reports have been published. It is considered that the present time is an appropriate one to review the work that has been done, with particular reference to the practical problems of supply undertakings. All the four authors have been closely associated with the E.R.A. researches; most of the work is now published for the first time.

It must be strongly emphasized that the value of the earth has an important bearing on the operation of high-voltage fuses and the protective gear installed. Earth leakage protection installed at the main points of an overhead ring main will ensure the safe operation of the switches by a high-resistance fault. If when the conductor falls the line is not cleared, such a fault may result in a serious accident.

Resistance earthing and so-called 'solid earthing' are general in Great Britain. Reactance earthing of the type practised in America is practically unknown, but tuned resistances (for example, Petersen coils) are now being installed to an appreciable extent. These coils are short-circuited occasionally, and consequently the earth resistance must be such as is required on an ordinary earth system.

In rural areas where the villages are far apart, and where each village is as a rule fed from one substation, the question of low-voltage neutral interconnexion does not occur, and it is here that the difficulty of earthing arises. On urban low-voltage systems it is generally easy to secure low resistances to earth, but in rural areas where water mains are frequently not available for earthing, there are serious difficulties. If it is proposed to work according to the regulations with just one earth, it is necessary to have the substation earth resistance very low (something less than five ohms), and this is frequently very difficult to secure.

In practically all instances in Great Britain where overhead lines have latticed steel towers for supports, these lines carry a continuous earth wire, the function of this wire being to ensure that all extraneous metal work is at earth potential, to act as a release for fault current, and as a protection against lightning. It has now been generally accepted that to make a line secure against lightning it is essential that the continuous earthed wire should be earthed at each tower and that this resistance should be less than about ten ohms. The foundations alone of these towers sometimes have a sufficiently low resistance for other protective purposes.

The earth resistance at consumers' premises should be sufficiently low to blow the largest fuses, but from the economical point of view this is not always possible. This has led undertakings to consider protective multiple earthing, neutralizing or earth-leakage circuit-breakers. The ordinary 18-in. square earth plate or the 3-ft. earth rod is of very little use

in the majority of soils found in rural England. Ordinary earthing—that is, one system earth at the substation and the consumer's earth utilizing the public water mains or the cable sheaths—has proved quite satisfactory in urban areas and has been the general practice in Great Britain. The main difficulty with ordinary earthing occurs when the system is overhead and is situated in a district without a piped water supply. The use of strip electrodes has been the means of reducing substation earth resistances to a reasonable figure and deeply driven rod electrodes have also proved useful.

The chief disadvantage of protective multiple earthing is the danger arising from a broken neutral conductor. To minimize the risk the earth resistance of the neutral is made as low as possible, and earths are provided at all consumers' premises. Where the soil resistivity is high (as would generally be the case) this represents a serious expense. The money might be more advantageously expended in ensuring that in the event of only a neutral breaking it would make contact with a live wire and so blow the fuse and disconnect the supply from the faulty section.

In order to determine the reduction of resistance effected by salting, and the frequency with which it is necessary to re-salt electrodes, tests have been in progress over a period of five years in five different sites where various extremes of soil conditions and rainfall exist. Tables are given showing the seasonal change of resistance of electrolytes and the effect of salt and coke treatment. Whilst salting reduces the resistance of earth electrodes it is generally recognized that it increases the rate of corrosion. The following conclusions are of practical importance. Failure of all electrodes in clay soil is caused by the attainment of a temperature of 100° C. at the electrode surface. At this temperature the moisture present evaporates, and the resistivity of the soil increases to a very high value. In clay soil with alternating currents, small leakage currents flowing for a long time do not impair the characteristics of an electrode, since they reduce its resistance. On the other hand, they seriously impair an electrode's characteristics if the electrode is connected to a positive lead. New work is now planned on the behaviour of different types of soil, the requirements of Petersen coil earth electrodes, and the behaviour of long electrodes and electrodes in parallel.

FIRE FIGHTING EQUIPMENT FOR ELECTRICAL INSTALLATION

LAST year the Electricity Commission requested the Electrical Research Association (E.R.A.) to consider what steps should be taken to try to prevent a repetition of one or two disastrous fires that had taken place in connexion with electric power stations and electrical installation. The E.R.A. appointed a committee to consider the whole matter and its report was discussed at the Institution of Electrical Engineers in London on January 25.

Mr. H. W. Swann, H.M. senior electrical inspector for the Home Office, presented the report and opened the discussion. Mr. Swann pointed out that when his committee first took the matter in hand there was a dearth of information available as to the performance of certain media used for fighting fires, and, hearing that a good deal of work had been done in Paris on this subject, the committee paid a visit there and obtained a great deal of information. But it was felt that something more should be done in Great Britain. Luckily, the co-operation was obtained of the County of London Electric Supply Co. at its power station at Barking, and also the help of the London Fire Brigade and the manufacturers of various proprietary media for dealing with fires.

Mr. McMahon introduced the report of the Committee and showed some colour films illustrating in a striking manner the starting and progress of the experimental fires and how they were extinguished. The length of the films taken amounted to $1\frac{3}{4}$ miles, about ten per cent of which were shown. The films were very instructive and many lessons were obtained from them. All the fires were artificially created and tests were carried out with methyl bromide gas, carbon dioxide, mechanical foam, chemical foam and water, as extinguishing media.

The recommendation made by the E.R.A. Fire Committee is that, for outdoor oil risks, the most suitable form of fixed installation is the atomized water type, or, if local conditions prevent this, then foam should be used. Failing either of them, inert gas media should be used, although when other media are available gas is not recommended. For indoor oil risks, it is stated that where weatherproof metal-clad gear is installed, atomized water will provide adequate protection, subject to precautions being taken to ensure that any apparatus not of the weatherproof type is not liable to suffer serious water damage. Where there are no draughts, gas protection can be applied, and although protection can be obtained with foam, there is the disadvantage that it leaves deposits which may hinder repair operations. For cables in enclosed spaces not liable to draughts, inert gas protection is effective under conditions of rapid operation. Difficulties may be encountered with water and foam. Much the same remarks are applied to cable galleries exposed to the atmosphere, and where gas is not safely applicable then water or foam installations will afford adequate protection. Certain recommendations are also made with regard to portable apparatus, and it is also recommended that back-up protection by means of water hydrants should be provided in case of emergency.

Mr. Nimmo, one of the Electricity Commissioners, remarked that whilst an examination of the films showed that the risk from oil is obviously so great that some might think that the use of oil-less switchgear should be enforced, yet it has to be remembered that there is a great deal of oil gear in everyday use, and steps have to be taken to protect it. In his opinion, water properly applied is the best medium; with the other media used in these tests, experts had

applied them. The ordinary user is still left wondering which is the best to use. Usually it was applied by the station personnel. The cooling effect of water gives it a tremendous advantage over carbon dioxide, methyl bromide or carbon tetrachloride. Accepting this, he suggested that for outdoor and indoor transformers and oil and bitumen-filled switchgear, an automatic atomized water installation might be used, and for cable basements and cellars where oil is not likely to be present, ordinary sprinklers would suffice. Finally, he prefers a water pressure of 60 lb. per sq. in. and a ten minutes storage supply to the 50 lb. and four or five minutes recommended in the report.

Mr. C. M. Kerr, who is an officer of the London Fire Brigade and was also a member of the Fire Committee concerned with these tests, spoke of the difficulty of laying down hard-and-fast rules for dealing with these fires and emphasized the need of ample back-up protection; to this, he thinks, too little attention has been given in the report. He also mentioned the need for attention being given to the maintenance of the various forms of fire fighting equipment as a consideration in determining their choice.

Mr. H. Bright said that although the title of the report was "Fire Fighting Equipment for Electrical Installations", it dealt, as did the discussion, solely with power stations. There are, however, installations, such as those in places of entertainment and elsewhere, where the risk of life from oil fires is very much greater than in power stations. In such cases, certain of the media mentioned must be ruled out because of their toxic or suffocating effects. In such places, too, it would be impossible to drain the oil from the transformers into pits, as was suggested for power stations. The alternative seemed to be to have a large tank.

Mr. Hacking, who replied to the discussion, said that the word 'emulsification' was deliberately not used in the report, because satisfactory results had been obtained using water, when there was no question of emulsification. He agreed that the smoke detector should only be used as a detector.

INSECT PESTS OF CROPS IN ENGLAND AND WALES

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

BULLETIN No. 118 of the Ministry of Agriculture and Fisheries, recently issued, records the incidence of the more important crop pests for the years 1935–37. The information upon which it is based has been supplied in the main by the advisory entomologists and other reporters. It appears that numerous foreign insects were intercepted by the Ministry's inspectors during their examination of imported plants and others were sent in by the general public. The great majority of these aliens were unlikely to prove either injurious or to establish themselves in Great Britain. A few, however, were of a different category and need brief reference.

The Colorado beetle (*Leptinotarsa decemlineata*) was represented by a few individuals found in the vicinity of London and Swansea. For the most part they were known to have been introduced through shipping, but no outbreak occurred during the period under review. The chrysanthemum midge (*Diarthronomyia* sp.) first occurred as an outbreak in 1927 but, by 1930, the pest was reported to have been eradicated. After an interval of six years a new infestation was discovered in southern England and appears to have had origin in plants or cuttings imported from the United States. In order to render the position more secure in future the importation of chrysanthemums has now been prohibited, except under special licence, which prescribes rigorous precautions to be observed.

The asparagus fly (*Platyparea pœciloptera*) had not been previously noted in England until it was discovered by C. Warburton in a garden in Hertfordshire in 1935. Subsequent work carried out by the Ministry's inspectors showed that it is too widely established in that county to render any attempt at eradication practicable. The species is a serious asparagus pest on the Continent of Europe and its presence in England may result in the shortening of the productive life of the beds, but it is probable that reasonable commercial control will be attained.

During the period under review, while many of the regular pests of English crops were prevalent, relatively few are specially noteworthy. Mention, however, must be made of the codling moth, which caused very serious damage in most fruit-growing districts during 1935 although it was much less troublesome in the two succeeding years. On the upland pastures of mid-Wales and parts of northern England, outbreaks of larvæ of the antler moth caused loss of sheep-keep. Wheat and oats were seriously attacked by the aphid *Myzus festucæ* in 1935, large acreages in many districts being almost completely ruined. As with the codling moth, the attacks were much less evident in the other two years.

Among unusual records larvæ of the sword grass moths (*Polia vestusta* and *exoleta*) attacking hops and of the holly blue butterfly (*Lycæna argiolus*) injuring raspberries are of interest.

The bulletin also gives a summary of progress as regards insecticides and their application, and concludes with a useful list of references to papers published in Great Britain, during the triennial period, which are concerned with crop pests and related subjects. Viewed as a whole the situation is very satisfactory. Possible danger from the introduction of the apple maggot from Canada and the United States and of the cherry fruit fly from various European countries has been reduced to small proportions by timely action being taken. Also the well-organized watch kept for the Colorado beetle has amply justified itself, since no outbreak has occurred; yet, on the Continent of Europe, its spread eastwards extends yearly and it now has an almost continuous range from southern France to central Germany.

SEVENTY YEARS AGO

NATURE, vol. 1, March 3, 1870

Natural Science at Cambridge

THE Rev. T. G. Bonney, the geologist, concluding an article on this subject, writes: "I may venture to express my conviction, that the coldness and even dislike with which the study of Natural Science was once regarded here is rapidly passing away, that the number of earnest students in the various branches is annually increasing, and that the University is fully alive to the wants of the age; so that, while she can never neglect or forget those old paths of Classics and Mathematics in which many of her sons have won an almost world-wide reputation, she will heartily welcome, and will regard with no less pride, all who are among the followers of sciences of a more recent date."

Measurement of Geological Time

ALFRED RUSSEL WALLACE presents the second and concluding article on this topic. He discusses, in particular, the effects of denudation as shown by Geikie's investigations. Surveying the estimates made by Tylor, Croll, Geikie and Lyell, he deduces a scale of geological time ranging from 24,000,000 years for the beginning of the Cambrian, to 2,000,000 years for the beginning of the Lower Miocene. He continues: "These figures will seem very small to some geologists who have been accustomed to speak of 'millions' as small matters; . . . Taking Sir William Thomson's allowance of a hundred million years for the time during which the earth can have been fit for life, it yet allows Mr. Darwin, for the process of development from the primordial germ, three times as many years anterior to the Cambrian epoch as have elapsed since that date, an amount of time which, I believe, will fully satisfy him, by whatever scale we may measure it."

Industrial Use of an Electric Motor

"FOR many years it has been a query whether the electric current might not be brought so far under man's control as to take the place of steam as a motor for machinery, and success has at last crowned the persevering efforts of scientists. At the last exhibition of the American Institute, there was seen an elliptic lock-stitch sewing machine, driven by a small electric engine which might easily be put into a common hat box. . . . The use of this motor, if it becomes general, cannot fail to prove of the utmost benefit to ladies, especially to machine operators, as it does away entirely with the necessity for using the feet, as is now the case, and must be highly conducive to the health of females, who suffer from many diseases that are generated by the constant strain on the pedal and limb muscles. The inventor of the engine in question is Charles Gaume."

"MR. E. RAY LANKESTER has been elected by examination to the Radcliffe Travelling Fellowship at Oxford."

THE *American Gaslight Journal and Chemical Repertory* states that Professor Loomis, who claims to have discovered a way to transmit messages by electrical air currents without the aid of wires, wants to be appointed Consul to some European port, that he may experiment on the summit of Mont Blanc.

APPOINTMENTS VACANT

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

TWO TEACHERS OF ENGLISH in Timisoara and Iasi—The British Council, 3 Hanover Street, W.1 (quoting 'Rumania') (March 9).

TECHNICAL ASSISTANT in the Mechanical and Electrical Engineer's Section—The Engineer and Manager, Waterworks Department, Town Hall, Manchester 2 (March 16).

ONE SENIOR ASSISTANT and SIX ASSISTANTS for Evening Institutes in Egypt—The British Council, 3 Hanover Street, W.1 (quoting 'Egypt') (March 18).

DIVISIONAL ENGINEER (WIRELESS) for the Malayan Postal Service—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9134).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry, Leaflet No. 7: Carbon Monoxide. Pp. iv+9+2 plates. (London: H.M. Stationery Office.) 1*s.* 6*d.* net. [142

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 793, Vol. 238: Stress Functions for a Plate containing Groups of Circular Holes. By Dr. R. C. J. Howland and Dr. R. C. Knight. Pp. 357–392. 6*s.* No. 794, Vol. 238: Crystallographic Studies of Meteoric Iron. By J. Young. Pp. 383–422. 6*s.* 6*d.* No. 795, Vol. 238: The Asymptotic Expansion of Integral Functions defined by Taylor Series. By Prof. E. M. Wright. Pp. 423–452. 4*s.* (London: Cambridge University Press.) [142

University of London Institute of Archæology. Geochronological Table No. 1: An Attempted Correlation of Quaternary Geology, Palæontology and Prehistory in Europe and China. By Wen-Chung Pei. (Occasional Paper No. 2.) Pp. 16+2 tables. (London: University of London Institute of Archæology.) 2*s.* 6*d.* [142

The Carnegie Trust for the Universities of Scotland. Thirty-eighth Annual Report (for the Year 1938–39) submitted by the Executive Committee to the Trustees on 12th February 1940. Pp. iv+90. (Edinburgh: Carnegie Trust for the Universities of Scotland.) [142

Imperial Bureau of Plant Breeding and Genetics. Field Trials: their Lay-out and Statistical Analysis. By Dr. John Wishart. Pp. 36. (Cambridge: School of Agriculture.) 2*s.* 6*d.* [142

Other Countries

Imperial Council of Agricultural Research, India. Scientific Monograph No. 13: Further Observations on Anatomical Deviations in the Ox and Notes on Certain Anatomical Freaks. By H. N. Chelva Ayyangar. Pp. vi+42+31 plates. (Delhi: Manager of Publications.) 2.8 rupees: 4*s.* [142

Reports of the Biochemical Research Foundation of the Franklin Institute. Vol. 5, 1938–1939. Pp. vii+42 papers. (Philadelphia: Franklin Institute.) [142

Transactions of the National Institute of Sciences of India. Vol. 2, No. 2: Changes brought in Colloids by Dialysis. By Dr. B. N. Desai and P. M. Barve. Pp. 39–68. (Calcutta: National Institute of Sciences of India.) 3 rupees. [142

Tanganyika Territory: Department of Lands and Mines, Geological Division. Bulletin No. 12: The Kimberlite Province and Associated Diamond Deposits of Tanganyika Territory. By Dr. G. J. Williams. Pp. 41+3 plates. (Dar es Salaam: Government Printer.) 3*s.* [142

Indian Forest Records (New Series). Entomology, Vol. 5, Nos. 4, 5, 6: On the Biology of the Parasites of the Teak Defoliators, *Hapalia machæralis* Walk. (*Pyralidæ*) and *Hyblæa puera* Cram. (Hyblæidæ) in Burma, by P. F. Garthwaite and M. H. Desai; Further Notes on the Biology of Parasites of Teak Defoliators in India, by C. F. C. Beeson and S. N. Chatterjee; On the Biology and Morphology of *Apanteles machæralis* Wlkn. (Braconidæ, Hymenopt.), by P. N. Chatterjee. Pp. ii+309+396. (Delhi: Manager of Publications.) 2 rupees; 3*s.* [142

Dominion of Canada: Department of Transport, Air Services Branch: Division of Meteorological Services of Canada. Canadian Polar Year Expeditions, 1932–33. Terrestrial Magnetism, Earth-Currents, Aurora Borealis: Chesterfield Inlet, Meanook, Saskatoon. Vol. 2. Pp. 185. (Ottawa: King's Printer.) [142

Instituto Nacional de Tecnologia (Ministerio do Trabalho, Industria e Comercio). O controle de concreto numa construção. Pelo Alberto Pastor de Oliviera. Pp. 21. Dosagem racional em tubulação de concreto. Pelo Adhemar da Cunha Fonseca. Pp. 52. (Rio de Janeiro: Instituto Nacional de Tecnologia.) [142

Catalogues, etc.

The Basic Cause of Ill-Health. By K. Cookson. Pp. 20. (Slough: Cooksonisers (Slough), Ltd.)

Pyelectan for Intravenous Pyelography. Pp. 2. Kapilon for Vitamin K Therapy. Pp. 2. (Greenford: Glaxo Laboratories, Ltd.)

Industrial Thermometers, Hygrometers, Manometers. (List No. 641.) Pp. vi+64. (London: C. F. Casella and Co., Ltd.)

OFFICIAL ANNOUNCEMENTS

MURDOCH TRUST

For the BENEFIT of INDIGENT BACHELORS and WIDOWERS of good character, over 55 years of age, who have done "something" in the way of promoting or helping some branch of Science.

Donations or Pensions may be granted to persons who comply with these conditions.

For particulars apply to MESSRS. SHEPHERD & WEDDERBURN, W.S., 16 Charlotte Square, Edinburgh, 2.

GEORGE HENRY LEWES STUDENTSHIP

ANNUAL VALUE £250 (about)

The above Studentship will be vacant on May 1, 1940.

The Student is required to give his whole time to research work except such as, in the opinion of the Trustees, does not interfere with his original inquiries. Candidates should send (*a*) a statement of their qualifications, and their need of pecuniary help, (*b*) the subject of their proposed research, (*c*) the name of one referee to Prof. Adrian, Department of Physiology, Cambridge, by April 1, 1940. The Studentship is not limited to either sex, and the Student is expected normally to work in the Department of Physiology, Cambridge, though in exceptional conditions he may obtain permission to work elsewhere.

ROYAL SOCIETY

GOVERNMENT GRANT FOR SCIENTIFIC INVESTIGATIONS

Applications to the Government Grant Committee for the year 1940 for grants for scientific apparatus, research expenses and materials, and in certain cases for travelling expenses incidental to research, should be made on forms to be obtained from the Assistant Secretary of the Royal Society, Burlington House, London, W.1. Applicants must be of British nationality. Grants for purposes of maintenance and publication do not fall within the scope of the Committee. Early application is desirable, and in no case can forms be received later than March 31 next.

UNIVERSITY OF BIRMINGHAM

FACULTY OF SCIENCE

PROFESSORSHIP OF MECHANICAL ENGINEERING

The Council of the University invites applications for the Chair of Mechanical Engineering, vacant by the death of Professor S. Lees.

The stipend offered is £1,100 a year.

Twenty-four copies of applications, which may be accompanied by copies of not less than three testimonials, references or other credentials, should be forwarded to the undersigned, to reach him not later than April 20, 1940.

It is desirable that the selected candidate should enter upon his duties on October 1 next.

Further particulars may be obtained from:

C. G. BURTON,
Secretary.

The University,
Birmingham.
February 1940.

COIMISIÚN NA STÁT-SHEIRBHÍSE

POSITION VACANT:

DIRECTOR OF THE GEOLOGICAL SURVEY

Application forms for and full particulars of a vacancy in the Department of Industry and Commerce for a Director of the Geological Survey may be obtained free from the Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin.

Age limits: 35-48 years, with extension of two years for established Civil Servants.

Salary: Man: £500—£20—£700 a year, plus cost-of-living bonus; woman: £400—£15—£600 a year, plus cost-of-living bonus. At present the bonus on £400 is £179 2s. and on £500 is £208 10s.

Essential qualifications: (*a*) Degree in Science, Geology being one of the subjects taken in the University Course, or an equivalent to such degree; (*b*) considerable experience of geological work in the field.

Latest date for receiving completed application forms: April 12, 1940.

BOOTHAM SCHOOL, YORK

Wanted in September, a master to teach Chemistry and Physics to H.S.C. and Scholarship standard. Good Honours degree and experience essential. Burnham 1918 scale with allowances. Master appointed will probably succeed to Senior Science Mastership in two years' time.

Apply for particulars to Headmaster, Bootham, c/o Ampleforth College, York. Complicated applications by March 22.

AIR MINISTRY

DIRECTORATE OF TECHNICAL DEVELOPMENT

Applications are invited for appointments as Assistants III for duty on Resident Technical Officer staffs at aircraft construction works in various parts of the country. Candidates should have had a good general education with some years practical training and Drawing Office experience, preferably including an indentured apprenticeship in general or motor engineering. Aircraft experience would be an advantage but is not essential. Experience in drawing up reports and in liaison duties between Drawing Office and works would also be an advantage.

Salary up to £214 a year and in exceptional cases above, according to qualifications and experience.

The appointments will be temporary and non-pensionable. Request for the necessary application form should be made by post card, quoting reference B.381. addressed to the Under Secretary of State, Air Ministry (B.127), Department ZA, Harrogate, Yorks.

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