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WELFARE AND TRAINING OF YOUTH

THE notable speech of Mr. R. A. Butler, President of the Board of Education, to a National Defence Public Interest Committee on December 10 is one of the indications which appear from time to time that the essential part of education both now and later has been realized. Mr. Butler claimed that his department is becoming recognized as the great national department of State for the training of the young. He gave the assurance that no further inroads on the teaching profession are contemplated at present, and he hopes the situation will never demand them. He viewed the registration of boys and girls of 16–18 years of age under the new National Service Act as a step towards building the arch from 14 to 18, and local authorities are being asked to do all they can to increase the facilities for training and service for boys and girls of 14–16.

These steps are not intended to take the place of the Fisher plan for continuation schools, but the scheme should accustom young people to the idea that in these early years the path to manhood and womanhood lies through knowledge and, broadly, citizenship. Mr. Butler indeed linked the scheme up with the idea of a new social charter, with its Bill of Duties as the counterpart of the Bill of Rights, which has been voiced in several quarters both in Great Britain and in the United States. From early youth, he said, the young citizen should learn that there must be acknowledged duties to be performed by the individual for the community, which should confer certain rights and privileges in return.

Mr. Butler's speech is the more encouraging to those who believe that the care of the children is the concern of the nation and that the welfare and training of youth are matters of supreme importance at all times because of the comparative neglect of education in the attention which has already been focused upon reconstruction. Despite the general recognition that the education of public opinion must be a prelude to effective action in almost every field, that has been viewed as mainly a matter of preparing opinion for change through some measure of adult education. There has been little indication of the conception of the education of the adolescent as part of a grand design embracing every aspect of life. The Minister of Labour has indeed already spoken in similar terms of the plans being initiated for the training of young people, and there is real promise in the evidence that Mr. Bevin and Mr. Butler are working together. Such co-operation should create the links between technical training and industry and commerce of which Mr. Butler spoke, and which are essential in the interests of both the individual and the nation.

Equally vital is the attention to voluntary training which will accustom young people, as Mr. Butler said, to the idea that in their early years the path to citizenship lies through knowledge, work and service. Inspired leadership should turn the eagerness of the juveniles to play their part in the war effort into channels which will fit them to play an equally or

even more important part in the tasks of reconstruction which lie beyond. It is this vision of the future of education that is pregnant with possibilities in reconstruction, and a notable article in the admirable series on our problems of reconstruction running through the *Round Table*, which is concerned with the future of education, has particular claims on the attention of the scientific worker.

Directing attention to the part which science—in the Latin sense of the word and not the narrow meaning to which we usually restrict it—has played in stimulating the educational developments of the last seventy years, the *Round Table* points out that in a world where life is increasingly based on knowledge, the uneducated man is useless or dangerous. He is no less incompetent as a soldier or citizen than as an engineer. The need to train the intelligence of all, in order to live in a civilization where as much intelligence as possible is required, sufficiently explains the recent development of education and why such development must continue.

Some lines of further development have been indicated in the Hadow and in the Spens Reports, and the creation of a democracy which can enjoy and sustain the new order of society foreshadowed in the Atlantic Charter depends on our implementing such proposals. That democracy cannot be created if education for the vast majority stops at fourteen, or if we fail to give them the right kind of education. The question of the content of education and how it is to be given is the unsolved educational problem of to-day.

In any scheme of national education we must provide, as at present, for two great classes—the few and the many. The composition of the first class will no longer be the same as at present, for it should be recruited from the whole nation, without distinction of birth or wealth, and should consist of those whom the community chooses to be its leaders because of their fitness to lead. The selection of this class will, in fact, be one of the most difficult problems for society, involving as it does one of the gravest dangers to education. Already the competitive examination system is corrupting the disinterestedness which is the essence of all good education and without which liberal education is impossible.

If we can deal with this problem and at the same time remove the grave defect of our newer universities emphasized in two recent books—that they teach rather than educate—we have still to face the larger problem of the higher education of the many. Here everything remains to be done, and no one can suppose that the mere implementing of the provisions of the Fisher Act will provide a solution. At the age of fifteen or sixteen education has only commenced; it has certainly not reached its goal. Education is intended to be used in life, and its meaning and importance cannot be apparent to an adolescent or even to an undergraduate who has seen nothing of life. It is this fact that gives value to part-time education for the adolescent, and to adult education, which gives men and women engaged in the ordinary business of life the opportunity to think about it systematically.

The article in the *Round Table* suggests that the time has come for the lessons learnt during the last forty years through the experience of the Workers' Educational Association to be applied to other sections of the community, as has already been done elsewhere in Europe. While, however, such experiments deserve close study, and notably the Danish People's High School, we must beware of merely copying other systems. Education should be inductive and clinical, based on a study of the 'patients', as well as deductive, and if we are to achieve that essential element in post-war reconstruction, as educated people, we must bring imaginative insight to bear on our problem, creative thought as well as administrative ability and energy. We must plan our educational system not merely to include refresher courses for teachers, medical men, scientific workers and other professional or specialist workers, but also to keep the human mind of the whole people growing and alive, giving them an opportunity of systematic study and a chance to think methodically about life when they have far more to think about than they can have at school or university.

Leaving on one side for the present the question of the part which the university and the secondary school have to play in such a frame-work of education, with its emphasis on education rather than instruction or teaching, there must be considered these three elements which are essential in any education adequate to the needs of to-day. All men need to make a living and the best that conditions permit. All have to live in a society and all need a scale of values, a sense of what is first-rate, in life as a whole, and so far as is possible, in its many provinces. To meet these needs education must provide a vocational, a social and a spiritual element, and it must do this not for a limited class but, in different ways, for every citizen.

Of the vocational element it need only be emphasized here that a society should give its educated members not only specialist knowledge but also some perception of the general conditions and possibilities of modern civilization, and a sense of the importance and uses of the techniques essential to it. It is a knowledge of science in this sense, indeed, that should form part of the education of every citizen and not of the specialist alone, just as it is the wide vision and sense of perspective implied in such a general conception that should correct the narrow specialism which has often warped the development of the scientific worker himself and hindered his participation in the work of the community. To that, indeed, a fuller corrective is the social or political education of which, largely under the pressure of the competitive examination system, he has so often been deprived.

Some training in the art of governing and, still more, of being governed; in independence and in respect for authority; individuality and team-work; self-assertion and self-discipline and self-sacrifice; initiative and subordination: the value of these becomes more apparent with every passing day of war. Their value will be no less when the nation turns once more to the tasks of peace, and they are

an essential part of the education of every citizen, whether he occupies a scientific, technical or administrative position or any other, just as some understanding of general science in the broad sense should make up part of his equipment for living in this modern world. The registration of boys and girls of 16–18 under the National Service Act can serve no more useful purpose than that of implementing this education in citizenship which certain institutions such as the Scout movement and the Youth Groups themselves are already imparting.

If we must discover new ways or forms for extending social education it is important that we should utilize to the full existing agencies and the foundations already laid. The *Round Table* article emphasizes the value of the public, or as it should be termed the residential, school, in training in the principles and practice of living in a community. This opportunity must not be thrown away, but the residential school, coming under the ultimate, though not necessarily direct, control of the Board of Education, should be open to every class in the community, and the right to entry should be based on merit, assessed not merely in terms of intellectual ability but also of character and personality. The further opportunities afforded by the growth of school camps, the development of the Youth Movement and of any form of national service or conscription which may persist after the War must also be seized for this education in citizenship and to promote mutual understanding between the different classes of society and thus to strengthen the national unity.

The third element is the most neglected and at the same time the most important and most difficult branch of education. Upon this, which for want of a better word may be termed spiritual education, the quality of our civilization, its standards, its sense of values depend. Without it we shall lack the driving force to carry through any adequate programme of reconstruction, national or international, which will make it endure. Knowledge or science, indispensable as they are in the framing of wise and impartial measures, are not enough. They cannot supply that habitual vision of greatness which, in Prof. Whitehead's phrase, is essential for moral education. They will not supply the driving force, the right standards, values and ideals without which no enduring social order can be built.

Difficult as this task must be, we must not be content with any system of education which does not give men both the chance of seeing the vision of greatness and of practising the virtues. New sources of that vision of greatness may need to be, and indeed are being, discovered. They can, indeed, be found in the quest of truth and the highest traditions of science, as in other fields of human activity, the Greek and Latin classics and in the Christian ideal and tradition. It must never be forgotten that science, economics and sociology can do no more than provide the framework of our society and satisfy its material needs. It is the vision and sense of values that spiritual education imparts that hold society together, supply its driving force and preservative against corruption. No pre-occupation, therefore, can excuse failure to place the spiritual element first in our system and to ensure that the vision of greatness from whatever sources it springs is available to all and not merely to the privileged few. The discussion on Science and the World Mind at the Conference on Science and World Order demonstrated that men of science are already thinking deeply about these problems, and they will be grateful for the evidence that Mr. Butler no less than his predecessor at the Board of Education is giving such close attention to the fundamental problem in all reconstruction—that of developing citizens, young or old, who can first reconstruct themselves.

PROGRESS OF GEOMAGNETISM

Geomagnetism

By Prof. Sydney Chapman and Prof. Julius Bartels. (International Series of Monographs on Physics.) Vol. 1: Geomagnetic and Related Phenomena. Pp. xxviii+542. Vol. 2: Analysis of the Data, and Physical Theories. Pp. x+543–1050. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 63*s*. net.

"THE earth itself is a great magnet." So wrote Dr. William Gilbert, fellow of St. John's College, Cambridge, nearly three and a half centuries ago. The detailed geographical determination of the nature of that magnetism, and the attempts to identify its origin, have since attracted much effort and friendly international co-operation. But, substantially, Gilbert's challenging statement still remains something of a mystery. For while much is now known of the origin of the small, but significant, periodic components of the earth's magnetic field, the genesis of the much greater quasi-permanent components continues unexplained.

The fundamental problem of the earth's main field is not rendered easier by the fact that that field is slowly changing. It is true that it does not change much in a human life-time, but, within astronomical and geological scales of time, the variation must be considered very rapid indeed. The direction of the magnetic north in England has, for example, changed by about 30° since Gilbert's time, while there are certain places on the earth's surface where the intensity of the magnetic field has altered by about 10 per cent during the last half-century. As a result of the early analyses of Gauss and Schmidt, it was established that the greater part of the earth's external magnetic field is due to causes operating beneath its surface. In fact, the earth behaves very much like a uniformly magnetized sphere with its magnetic axis making an angle of 11½° with the geographical axis of rotation. But the average intensity of magnetization has to be regarded as very much greater than that of the ordinary crustal rocks so far examined. To account for this is the central problem of geomagnetism.

Fortunately it is only the problem of the semi-permanent magnetism of the earth which proves so intractable. The transient changes of magnetism, which are to be noted during a period of time measured in hours, are not so unaccountable. They are known to be due to causes operating outside the earth's surface, as was also shown by the Gauss-Schuster analysis. They are superposed on the slow secular

variations of the main field and may be divided into two classes: the regular solar and lunar diurnal variations and the more erratic variations characterized as magnetic storms. Both classes of variations are found to vary in intensity through the sunspot cycle.

Since, so far as we know, magnetic matter does not exist in the space round the earth, the primary part of these transient magnetic changes is probably due to electric currents. According to the bold speculation of Balfour Stewart, advanced in 1882, such currents are to be attributed to dynamo action in the earth's upper atmosphere. Now the essential feature of a dynamo is that it contains an electrical conductor moving in a magnetic field. The magnetic field is already provided by the earth, and Balfour Stewart suggested that the electric conductor is the rarefied upper atmosphere itself, which is made to move periodically across the magnetic field by the tidal and thermal action of the sun and the moon. That Balfour Stewart was correct in the essential postulates of his theory has been proved in experiments carried out in Great Britain. Thus, radio experiments in 1925 showed that the upper atmosphere is permanently ionized to a marked degree, while, twelve years later, similar experiments disclosed quite unexpectedly large tidal motions of that conductor resulting from the gratitational influence of the moon. Further evidence showing the connexion between ionospheric events and the ephemeral changes of terrestrial magnetism has been obtained in the study of ionospheric phenomena through the sunspot cycle. Radio experiments have shown that, at certain levels, the electrical conductivity of the upper atmosphere increases by about 50–60 per cent from sunspot minimum to sunspot maximum. During the same period there is a corresponding and equal enhancement of the solar diurnal variation of the earth's magnetism. By the same radio technique it has been further shown that this remarkable change in the ionosphere is caused by what may be as much as a 150 per cent increase in solar ultra-violet radiation.

But, although great progress has been made in disclosing the nature and identifying the causes of these transient variations of the earth's magnetism in work carried out since the nineteenth century, there has not hitherto been available any up-to-date account of such recent progress. In this book, "Geomagnetism", we have, however, the most satisfying fulfilment of this need. Those who know the subject would have chosen no other authors for its *magnum opus*. In zealous devotion to the subject over a period of many years, each has enriched our knowledge of both the nature and significance of the temporal magnetic variations; while Prof. Chapman's theoretical studies of ionized layer formation have greatly assisted those ionospheric physicists who have used the radio wave as a supplementary tool in exploring the nature of the upper atmospheric dynamo.

The two substantial volumes into which the work is divided cover the subject both widely and closely. The first volume contains an exposition of the magnetic facts, as gleaned from years of observation, and also includes briefer, but up-to-date, accounts of related subjects such as earth currents, auroral phenomena and ionospheric characteristics. The second volume is in two parts. In the first there is a most illuminating description of the mathematical apparatus which has been devised, much of it by the authors themselves, for use in the analysis of such complicated phenomena as result from the simultaneous influence of the sun and moon on the terrestrial atmosphere. In the second part of the volume there are expounded the physical theories which have been evolved to explain the facts as more simply revealed by such mathematical analysis. The two volumes, which are generously illustrated both by diagrams and plates, together include about a thousand pages of text and are very well furnished with bibliography and indexes. Particularly useful to the research worker will also be the tables of long series of magnetic and solar data brought up to the year 1937, with convenient spaces for the inclusion of later values.

Distinguished and scholarly in treatment, "Geomagnetism" will assuredly become a classic. Its publication has instantly increased the already considerable debt which workers in this and allied fields already owe to its two authors.

E. V. APPLETON.

RAW MATERIALS

Those Raw Materials

An Introduction to the Study of Raw Materials. By C. A. Ward. Pp. 392. (London: George Allen and Unwin, Ltd., 1941.) 15*s*. net.

DESCARTES, it will be remembered, resolved to seek happiness by limiting his desires rather than by attempting to satisfy them, thus setting himself against the grain of common human endeavour. In these times, thanks to science, invention and advertising, our needs have multiplied like the seed of Abraham, and although some of them appear superfluous, or even harmful, many can be ethically justified on the score of self-preservation or self-development.

Very early man seems to have thrived on a dietary of berries, eggs and shellfish, and on clothing made of leaves and of the bark of trees; his heirs have scoured land and sea to find and exploit materials that administer to their well-being, and when frustrated they have fought—and still fight—for possession or control of them. The spirit of adventure, now believed to be on the decline, and the instinct of acquisition, still very much to the fore, have brought within range an almost untold wealth of raw materials which, when used rightly, add to the sum of human happiness, but, when used wrongly, lead to envy, hatred, masochism, sadism, and their sequel—war. Unfortunately, though there is seeming abundance for all, the will to dominate and possess has operated to alienate much of the world's natural wealth for the possession and enjoyment of the few, and this process has been assisted by the extremely haphazard way in which raw materials are distributed over the earth's surface (air, and to some extent water, excepted). That is not the fault of man. Nature—personified as a woman, somewhat unchivalrously to the fair sex—does not, like the moon, always show the same face to beholders. She can be exceeding fair, but she can be red in tooth and claw; generally she seems to be supremely indifferent to human welfare: as callous as was Herod to the Holy Innocents, or is Hitler to the Jews. The teleological doctrine, which *reads into* Nature a benevolent purpose, has now joined the scrap-heap of discarded wish fulfilments, and virile folk have come to realize that man is largely the master of his

own fate: it is he alone who can smooth out some of those grosser inequalities of natural wealth and human endowment that undermine men's sense of security and lead to bitterness and strife. The Atlantic Charter has done well in postulating equal access to raw materials as a *sine quâ non* of a lasting peace.

Mr. Ward's introduction to the study of raw materials gives a good idea of their range and their uses; except when he wanders off into electronic theory, his treatment is entirely factual, consisting mainly of short notes and brief descriptions. Its main defect is that, with the exception of the chapters on coal and petroleum, it ignores the very important economic background; there is no discussion of rates of exhaustion and probable lives of mineral deposits, of improved means of extraction and conservation, or of geographical distribution in relation to marketing; and there is no map. On the other hand, much space is devoted to "metallurgical treatments as applied in the final preparation of metals", and to materials which cannot be accurately classed as 'raw'. Thus he devotes two chapters to chemical products, among which are included many intermediate substances, as well as finished products like dyestuffs, explosives, lead compounds, synthetic rubber and artificial silks. But little consideration is given to those ubiquitous raw materials, atmospheric nitrogen and oxygen, and water, which in recent times have been used more and more by the chemical industry. The future importance of the exhaustion of supplies of rock phosphate is ignored, as also are the possibilities of using sea-water as a source of commercial magnesium, potassium and bromine, and clay as a source of aluminium.

Criticism must also be extended to certain defects in literary style. Sir A. Quiller-Couch's lectures on "The Art of Writing" are still largely ignored by technical writers. Among the stylistic sins he denounced was the use of circum'ocutory and redundant expressions, like 'in the case of', 'in connexion with', and 'as regards'. In the book under review the first of these occurs hundreds of times, and 'in the very first place' is a frequent substitute for 'first' or 'firstly'. The schoolboy error of referring to one thing, or to the last of three or four things, as 'the latter', disfigures many sentences. The title also savours of 'journalese', and in conformity with it the author overdoes the journalistic 'while', reminding one of A. P. Herbert's example: "The curate read the lessons while the vicar preached the sermon".

Books on scientific and technical subjects intended for the general reader are notoriously difficult to write. The first consideration for an author is to 'remember the reader' and adapt his style to the class of reader he has in mind. For the reason just mentioned, Mr. Ward's book cannot be recommended for use in schools, and the serious student will find it too fragmentary and too lacking in insight to meet his purpose. It will probably appeal most to the middle-aged man who wishes to rub up and extend the knowledge he acquired long ago; he will find it especially useful in reading company reports and similar 'literature'. One cannot help feeling that the author has lost an opportunity to write a book of real human interest, one that touches life at many points besides the purely technical. When he is asked to revise the present edition, perhaps he will try to convert his own 'raw material' into a finished product.

E. H. TRIPP.

INDUSTRY AND ITS HAZARDS

The Ana'ytical Chemistry of Industrial Poisons, Hazards and Solvents

By Dr. Morris B. Jacobs. (Chemical Analysis, Vol. 1.) Pp. xviii+661. (New York: Interscience Publishers, Inc.; London: H. K. Lewis and Co., Ltd., 1941.) 7 dollars; 42*s*.

AT the present time, when the future of Great Britain and the very lives of our people depend upon the output of industry, the safeguarding of the health of industrial workers is a matter of supreme importance. We are prepared, therefore, to welcome any contribution which may be a real help in improving the health of the worker or combating any condition which may be toxicological or otherwise deleterious. Although there is quite a number of publications dealing with industrial medicine and hygiene, there has been comparatively little published in connexion with the analytical chemistry of industrial poisons. This book attempts to fill this gap and though the treatment of the subject is somewhat uneven, and though there are a good many gaps, it does give something of value in dealing with the particular hazards which are met with in industry.

The preliminary chapters are devoted to sampling procedure and practice, and the methods given for obtaining samples of dust and gases are very good and helpful, as are the methods of dust and gas analysis. In the chapters dealing with the metallic poisons, the methods adopted are clearly set forth, but there is often too much descriptive matter for the skilled chemist, and not enough for the person who is not accustomed to carrying out the particular tests described. One might also question the value of the clinical and physiological information which is given. It is in general correct, but it is insufficient to be of any particular use and it is difficult to ascertain to whom it might appeal.

Industrial solvents and their examination are carefully and adequately described. The author in his colorimetric tests does not appear to use the colorimeter, but depends on using standard colours and matching them by the eye. There is a condensed but useful chapter on the gases of warfare; tables of concentration limits of exposure for fumes, vapours and dusts; the toxicity data of various gases and vapours in the atmosphere, and the limits, inflammability and explosive range of substances likely to be met with in industry.

There is a fairly wide and up-to-date bibliography, mainly referring to publications in the United States, but this is not unexpected as a great deal of the work in industrial toxicology has been carried out in that country.

The index could be greatly improved, and where a number of references are given, some indication should be made as to the more important ones by stressing them in darker type or some other convenient method.

In future editions the author would do well to use the initial or Christian name of the various authors in his references, for without this it is almost impossible to obtain any idea of the authorship of a particular paper, especially if the name is a common one.

Taking it all round, the book is sound, and should be of service to those dealing with industrial medicine and industrial toxicology.

ROGER JOSEPH BOSCOVICH

Roger Boscovich, S.J. (1711–1787)
Forerunner of Modern Physical Theories. By H. V. Gill. Pp. xviii+76. (Dublin: M. H. Gill and Son, Ltd., 1941.) 7*s.* 6*d.*

THOUGH the author speaks (p. 64) of "Newton and other scientists of the time, including Boscovich" as though they were roughly contemporary, this is clearly misleading; for Newton was nearly seventy when Boscovich was born at Dubrovnik (Ragusa) in Dalmatia. This means that one was a man of the seventeenth, the other of the eighteenth century. Similarly, when at the outset of his "Theoria Philosophiae Naturalis", Boscovich asserts that his own system is midway between that of Leibniz and that of Newton, it may be suspected that this is true in the sense that, but for the matter of dates, both would have expressed equal disagreement with his ideas. It is, in fact, hard to understand what he did mean, for the particles of his system never came into mutual contact and they are not subject to the action of a surrounding medium. Yet Boscovich emphatically denied the possibility of action at a distance.

In spite of this inconsistency in his natural philosophy, Boscovich was a voluminous writer who achieved a considerable reputation in his lifetime and even now cannot be dismissed altogether lightly. In order to understand these facts it is necessary to have a clear account of the physical theory which Boscovich developed. But the present small work scarcely touches the history or explains why the theory took the shape it did, or in what way it was founded on the contemplation of experimental facts. In the absence of this background the system seems purely intuitive and to owe its power of adaptation to later problems to good fortune rather than to intrinsic merit.

Indeed the origin of this eighteenth century system seems to have been in the main metaphysical. Its greatest influence was exercised in Great Britain, and particularly in Scotland. In this way it came to the attention of Lord Kelvin, who found a use for it in his later work on elasticity and molecular physics. Similarly J. J. Thomson, when presented with the puzzling properties of his newly discovered electron, had recourse to the ideas of Boscovich. Now again Fr. Gill recalls the Boscovichian corpuscle and sets it to the task of explaining the interference and diffraction of light, the Bohr atom and even wave mechanics in a primitive form. More than this, Boscovich had some clear ideas of the principle of relativity as it involves the perception of scale and orientation. His view of space and time was interesting, though clearly derived to a great extent from the Newtonian theory of fluxions.

The Boscovichian particle is an infinitesimal centre surrounded by a field of force which is alternately an attraction and a repulsion at different close distances, ultimately becoming a positive attraction of the normal gravitational type. Further than this the nature of the particle is undefined, and so it makes a capital plaything for the physicist. But more is wanted to establish a scientific reputation on a sound foundation, and contacts with the past are even more important than contacts with the future.

Hence it may be regretted that here so slight a sketch of the life and character of Boscovich has been included. Yet, if the object was to present a scientific hero, it may have been wise. In truth, Boscovich seems to have been spoilt by success in early life. His character was warped by vanity, egotism and petulance; finally, disappointed with the measure of appreciation which came to him, he became the prey of melancholy and before his death sank into fits of madness. Reverting to the practice of an earlier age, Boscovich wrote a long work, "De Solis et Lunæ Defectibus", a synopsis of astronomy in verse, which Delambre described as uninstructive to an astronomer and unintelligible to anybody else. It is hard without proof to accept the legend of greatness. In some ways Boscovich seems a survival from an age long past rather than a forward-looking man of the eighteenth century. For that century had its really great men, and Boscovich can scarcely be reckoned of their company.

H. C. PLUMMER.

NEWTONIAN ATTRACTION

An Introduction to the Theory of Newtonian Attraction
By A. S. Ramsey. Pp. ix+184. (Cambridge: At the University Press, 1940.) 10*s.* 6*d.* net.

THE preface states that this book was written at the suggestion of some students who were unable to find a book on the subject suitable for their requirements. The seven chapters deal with preliminary mathematics; gravitational attraction and potential, simple applications; attraction and potential internal points, spheres; theorems of Laplace, Poisson and Gauss, general theory; Green's theorem; harmonic functions; attraction of ellipsoids.

In writing an account of a branch of applied mathematics in which the subject-matter has long since been stabilized, an author can still choose his method of presentation, and it is interesting to see that in the first chapter the reader is introduced to vector methods. With the vector notation established, one rather regrets that the matter is not pushed to a conclusion with the introduction of Gauss's general theorem in the symbolic form

$$\int n\,X\,dS = \int \nabla\,X\,dv$$

for the relation between surface and volume integrals. From this form flow the various particular cases of this theorem and Green's theorem. There is the added advantage that the emphasis is thus laid on a statement which is of general application to potential theory whether in gravitation, electricity, magnetism, or hydrodynamics. Indeed, the student of any one of these subjects is seldom forcibly presented with a clear picture showing how much belongs simply to general mathematics and how much to the particular subject which he is studying. Gauss's normal induction theorem and Poisson's equation may be cited as instances.

The book as a whole is intended for students taking an honours course, but the needs of the student reading for a pass degree are not forgotten. The author writes with the clarity and flair for exposition to which readers of his other text-books are accustomed. There are numerous examples at the end of each chapter, many taken from Cambridge and London papers, the easier examples being divided from the more difficult. The book completes the series on mechanics which the author has produced in recent years and takes a worthy place among them.

L. M. MILNE-THOMSON.

A Laboratory Manual of Electricity and Magnetism

By Leonard B. Loeb. Revised edition. Pp. xii+122+112 Experiment Data Sheets. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1941.) 22*s*. 6*d*. net.

THE author raises the old controversy about laboratory work in teaching: Should the student be confronted with a set of apparatus to do an experiment with a title, left with the minimum of prompting to work out the procedure and results to be obtained, and then be given a week or two to write the work up in his own way for subsequent correction by authority, or should he be persuaded to read up previously from specific instructions exactly what he has to do, what theory he is supposed to imbibe for the proper assimilation of the scientific work performed, be given a printed form to fill in with the stated observations and indicated calculations, and so close the deal within a specified laboratory time? Supposing that the latter is the correct procedure, the author could scarcely be bettered in working out a requisite plan. He claims that the hour given to private study, with printed relevant theory (because no course of laboratory work can keep in step with lectures), including pictorial diagrams of connexions (which, we must admit, we had thought had faded out of text-books long ago), before being confronted with the apparatus, leads to a greater efficiency in exercising the student's mind and a more speedy implantment of useful scientific principles. The scheme was developed to avoid the misuse of heredity principles in the recording of experimental work among students.

The experiments in elementary physics are well selected, but they would certainly have been done by scientific students before they reach college in Great Britain. The data sheets, of which several sets are appended, are also impressive. Nevertheless, one feels that the regimentation here presented is a line of least resistance to meet time-table pressure and inadequate laboratory facilities. If it produces the required results, how are these results measured?

L. E. C. H.

Wolf Child and Human Child

The Life History of Kamala, the Wolf Girl. Based on the Diary Account of a Child who was reared by a Wolf and who then lived for Nine Years in the Orphanage of Midnapore in the Province of Bengal. By Dr. Arnold Gesell. Pp. xv+95+8 plates. (London: Methuen and Co., Ltd., 1941.) 6*s*. net.

DR. ARNOLD GESELL has given here a psychological appreciation of the effect on a human child of her transfer in infancy from a human to a lupine family, and of her retransfer after eight or nine years to a human one, based upon the story of an Indian girl recovered in 1920 from wolves. The full story was recorded in a diary kept by the Rev. J. A. L. Singh, under whose care she spent the next nine years, and is to be published by Prof. Zingg of Denver University. Dr. Gesell's account therefore suffers from being based on facts not completely accessible to the reader. In some respects it is hypothetical; we are given a reconstruction of Kamala's unknown infancy and of her eight years with wolves. Some such imaginative reconstruction is probably necessary to the development of Dr. Gesell's theme, which is the interaction of nurture and nature in the formation of culture, and the powers of adaptation, particularly to psychological and cultural environment, of the normal human child, but his approach could have been more strictly scientific and less literary. Any judgment on the facts upon which Dr. Gesell relies would be out of place before the publication of the diary and details which Prof. Zingg is preparing. It will be awaited with no little interest by the readers of Dr. Gesell's book, which will prove, if the facts can be accepted, an important contribution to the study of child psychology and the transmission of culture.

Waves

A Mathematical Account of the Common Types of Wave Motion. By Dr. C. A. Coulson. (University Mathematical Texts.) Pp. xii+156. (Edinburgh and London: Oliver and Boyd, 1941.) 5*s*. net.

THIS book, intended for honours students of mathematics or physics in the final year of their degree course, gives an elementary account of many different types of wave motion. The first chapter contains the fundamental differential equation and its most important types of solution. Chapters ii–v deal with waves in strings, membranes, bars and liquids. Chapter vi is concerned with sound waves, and Chapter vii with electric waves. Finally, Chapter viii returns to general considerations, including the Doppler effect, beats, group velocity, wave packets, Fresnel's principle, and the theory of retarded potential. Each chapter contains a set of important and interesting problems, to which the answers are given. Lack of space is responsible for the omission of elastic waves in continuous media and of radiation from aerials, and some of the work is unduly condensed, in particular the solution of the fundamental equation on p. 7. The book as a whole is very good, and supplies a surprisingly large amount of information in a small compass and at a low price.

Functions of a Complex Variable

With Applications. By E. G. Phillips. (University Mathematical Texts.) Pp. xi+140. (London and Edinburgh: Oliver and Boyd, 1940.) 4*s*. 6*d*. net.

THIS pleasant and moderately priced little book forms an excellent introduction to the complex variable. It is written in a brisk and lucid style, and may be confidently recommended to students of pure or applied mathematics. It will appeal in particular to those who wish to understand the mechanism of conformal transformation. The titles of the five chapters are: functions of a complex variable; conformal representation; some special transformations; complex integral calculus; calculus of residues.

L. M. M.-T.

Physics for Engineers

By Sir Ambrose Fleming. Pp. xii+232. (London: George Newnes, Ltd., 1941.) 7*s*. 6*d*. net.

SUCH a wide field can be covered only sketchily in so few pages. Nevertheless, many fundamental principles are outlined and historically traced, with references to sources and proofs. The symbols are not entirely consistent, or in accordance with international standardization, but their meaning is always clear. The value for the student is the historical perspective he can profitably have induced in him and the insistence of the correct derivation of the units he habitually uses.

L. E. C. H.

FEEDING POST-WAR EUROPE

By DR. GEOFFREY BOURNE

University Laboratory of Physiology, Oxford

IN the Atlantic Charter one of the primary post-war objects of the British Empire and the United States is that of freeing the peoples of the world from want. Much has been said and written of plans for post-war reconstruction, and of these that of feeding Europe must be put into operation the moment the War ends, and, unless it is provided for, a situation might well develop which will become completely out of hand.

The problem of feeding Europe after the War is really a dual one. First we must have supplies of the right foods which can be rushed to Europe as soon as hostilities cease. Then, secondly, we must plan for the continued feeding of Europe; and that means planning not only European, but also world agriculture. This latter problem was brilliantly discussed by Sir John Orr at the British Association Conference on Science and World Order last September.

Here it is proposed to deal with the more immediate problem: What foods must the British Empire and the United States hold in readiness to rush to Europe with whatever shipping they can beg, borrow, or happen to have left themselves when the War ends? But before we discuss this matter it is necessary to review the present food position of the various countries of Europe and attempt to predict the direction which food deficiencies will take.

The population of Europe can be divided broadly into two groups of people: the peasant population and the townspeople. The peasants will probably not suffer any serious food deficiency whatever the length of the War. They are the producers, and it is difficult for any nation to ration severely those who produce the food. It is the urban population who will suffer. Not only is food production lowered and imports reduced, in some cases to practically nothing, but in many countries such as Italy, France and Belgium the peasant is withholding grain which might have been sent to feed people in the towns and instead feeding it to pigs and poultry, which sell at considerable profit on the 'black market'. In each country there is also a small well-to-do section which is unaffected by dietary stringencies. These are the people who patronize the black markets, or the hotels and restaurants which do so, or who are able to make up their dietary requirements with the aid of expensive unrationed foods.

Black markets thrive in all the occupied countries, but some are worse than others. Belgium has the biggest black market in Europe. It was so bad that Germany refused to give any help to that country until the Belgian authorities assumed control over all the essential foodstuffs. During 1940 and 1941 huge hoards of black market food were seized from the various restaurants and shops. Even bread is sold on the Belgian black market, and there are reports that potato skins have been sold there too. Black markets closely rivalling that of Belgium exist also in Luxemburg, France and Italy.

Bread is rationed in all the occupied countries and in Germany itself. In some countries where the allowance is generous there is little hardship; for example, Germany 80 oz. a week, Denmark 85 oz., Slovakia 80 oz., Bulgaria 74 oz. In others where it is low, for example, Italy 50 oz. a week, Belgium 55 oz., Greece 30 oz., there may be danger of starvation. (All figures are those for normal consumers.) One may think that 30 oz. of bread is a fairly generous allowance, but such an amount is seriously low when there is so little else to eat. Thirty ounces of bread a week provide about 300 calories a day. The daily requirement of a normal consumer is about 2,800 calories, so that a diet which supplies only 30 oz. of bread a week may be a starvation diet if there is not plenty of other food with which to make up the calories. One way of doing this, in a diet deficient in bread, is by eating a lot of fats or potatoes; but in most countries fats are rationed and in some potatoes also. Belgium has a potato ration of 1 lb. a day, which supplies only 400 calories. Potatoes are not rationed in Greece; but this is of little value because they do not normally form a significant part of the Greek diet. The fat ration is lowest in Finland, where it is 2½ oz. a week; it is very low in Belgium and Italy (3½ oz. a week), and in France (4 oz. a week). The highest fat rations on the continent of Europe are enjoyed by Denmark with 11 oz. a week, and by Germany with 9½ oz. a week.

Meat is officially rationed in all but one country, namely, Denmark. The amount of the ration is not known for all countries, but from the figures available it appears that it is lowest in Belgium (8½ oz. a week) and France (9 oz. a week).

Sugar is rationed in all countries, the lowest being in France, Italy and parts of Hungary (4½ oz. a week).

Besides these standard foods which are rationed, many others, for example, cereal products, cheese, milk, flour, fruit, vegetables, fish, poultry, biscuits, cocoa, chocolate, jam, eggs, etc., are nationally or locally rationed.

In view of the difficulty of satisfying the calorie requirement in France the people have been urged to drink more wine, which has a calorific value of about 350 per pint. This they have done to such good effect that wine has now been rationed. The adult ration is about two litres a week. In Italy most of the population drinks, on an average, half a pint of wine a day and this provides an appreciable proportion of their calorie requirement.

The only countries in Europe to-day in which there is no food rationing are Portugal and Turkey.

Assuming that the average calorie requirement for a non-combatant or normal consumer (that is one not doing heavy manual work) is about 2,800 a day, we can, by examination of the average calorie intake in the various countries of Europe obtain a more accurate estimate of the gravity of the food situation. In the first place, Germany and Denmark have suffered very little so far. The average figure for daily calorie intake in the former is 2,900 and in the latter 3,100. In some of the other countries, however, the figures are not so good. They are the "Protectorate" (Bohemia and Moravia) 2,300, Italy 2,400, Norway 2,500, Occupied France 2,100, Unoccupied France 2,160, Netherlands 2,250, Belgium and Luxemburg 1,870. It is impossible to estimate the calorie intake in Poland and Greece because of the difficulty of obtaining figures for food consumption; but it is almost certain that they are at least as badly off as Belgium. In fact, it seems certain that Greece has been near famine for some months and that the food situation there is now extremely grave. In Poland there is no uniform system of rationing. Germans appear to be unrationed and the Poles

receive a better ration than Jews. These figures indicate that many of the peoples of Europe are undergoing slow starvation. It is probable, too, that the figures given represent a rather optimistic estimate of the calorie consumption in Europe.

Deficiency occurs not only in quantity of food but also in quality. There is a serious decrease in the amount of protein eaten, and if this continues, as it is likely to do, it will have a serious effect on the general health of the people of Europe, particularly that of growing children.

There is little doubt that there is a deficiency of certain vitamins. Some months ago Dr. Russell M. Wilder, chairman of the American National Nutrition Council, stated that Germany was starving the peoples of the occupied countries of foods containing vitamin B_1 with the object of lowering their morale. (Adequate vitamin B_1 is claimed to be necessary for the maintenance of morale.) In actual fact it appears that supplies of wheat are so low in Europe that it has been found necessary to extract the grain as far as possible to make the best use of it. Thus most of the wheaten bread eaten in Europe to-day is at least 85 per cent extraction, and is therefore bread comparable with our own National wheatmeal loaf which is relatively rich in vitamin B_1 and most of the other members of the vitamin B complex. We can, therefore, safely assume that of all the vitamins, those of the B group which are found in whole cereals are least likely to be deficient in post-war Europe.

The decrease in the consumption of milk, cheese and butter will result, however, in a reduction of intake of vitamins A and D and of riboflavin. The widespread deficiency of vitamin D may have serious effects, particularly in adolescents who get no priority in food, and who, of all groups in the population, need more of everything. The increase in the use of whole-grain products combined with a restriction of milk will probably cause a widespread calcium deficiency.

In Great Britain an investigation of a series of middle-class diets by E. M. Widdowson and B. K. Alington[1] has shown that the restriction of fruit in the diet has not been compensated for by an increase in the amount of vegetables eaten, and that, therefore, the vitamin C intake has been reduced to half that consumed by the same families in 1935. It is very likely that in Europe there has been a similar decrease in the vitamin C intake of the population, and it is fairly certain that the intake of vitamin C will continue to decrease ; but that in most countries it will not reach a level in which there will be serious danger of frank scurvy unless there is a widescale failure of the potato crop. The same principle will apply to Great Britain unless the consumption of vegetables is increased by inspired propaganda. The populations of some countries, such as Norway, Greece and Poland, are probably suffering now from at least a mild form of scurvy and there is every likelihood that this will become worse. Last winter in Norway, even the German army of occupation began to develop scorbutic symptoms, and at the onset of this winter, according to reports, vitamin C tablets were taken to the German army on the Russian front by aeroplane.

It is probable that at the end of this War the following dietary deficiencies will occur to a greater or lesser degree on the continent of Europe.

(1) Absolute lack of food. There will not be enough food to supply the calorie requirements of the populations.

(2) Deficiency of protein, particularly first-class protein.

(3) Deficiency of vitamin D.

(4) Deficiency of vitamin A.

(5) Deficiency of vitamin C.

(6) Deficiency of riboflavin.

(7) Deficiency of calcium.

The difficulty of securing an adequate diet particularly for the 'susceptible classes' (children and pregnant women) is appreciated by the authorities in all European countries. There is a fear in Occupied France of deficiencies, in particular of vitamins A and C, and it is proposed to produce vitamin concentrates from tunny fish liver, carrots, brewer's yeast and lemons to correct these and other possible deficiencies. Children between the ages of six and fifteen are to receive a free distribution of tablets containing vitamins A, C and D. Expectant mothers and children are to receive a portion of a distribution of 160 million vitamin pills which are to cost thirty-five million francs. All European countries are attempting by distributing vitamin pills, or by giving priority in vital foods, to keep their expectant mothers and children in good health. In Luxemburg children get free vitamin A and D capsules. In many Belgian schools the children have been eating a raw carrot every morning, and it is now proposed to distribute to them free milk, chocolate and cod-liver oil. An illuminating sidelight on the Belgian food situation is given by an advertisement which was published last year in a Ghent newspaper, which offered free supplies of vitamins A, C and D to all young men who joined up with a voluntary labour organization. In Germany in the springs of 1940 and 1941 vitamin C tablets were issued to school-children, nursing mothers, infants, soldiers and miners. Heavy workers were included in 1941. In some parts of Germany milk for infants is irradiated to increase its vitamin D content, and from three months onwards babies can receive a vitamin D preparation from the clinics. There seems to have been a possibility of vitamin A deficiency in the German diet, but it was not until January of 1941 that this vitamin was added to margarine.

Having indicated briefly the possible deficiencies which may arise it is now necessary to consider what foods will be required to remedy them. Two foods spring immediately to mind. First, wheat, and secondly, dried milk. Flour of high extraction will supply calories (1,600 per pound, 1,100 per pound when made into bread) and vitamins of the B group. The dried milk may be skimmed or whole. Whole dried milk does not keep as well as the skimmed variety and it would probably be better if the milk were skimmed, and the fat so obtained turned into dehydrated butter which will keep for a much longer time than dried whole milk. The dried skimmed milk will be an excellent source of first-class protein, of sugar, of riboflavin and of calcium. From the dehydrated butter we shall obtain fat (providing 4,200 calories per pound) and the fat-soluble vitamins A and D.

The amount of drying plant and the storage area available are the factors which will limit the amount of dried milk and dehydrated butter which will be available. It will, therefore, be necessary to store extra fats such as whale oil, concentrates of vitamins A and D, and further supplies of protein in the form of dried meat and fish. Some soya bean flour could also be stored with the object of adding it to wheat

flour to give an augmented protein and calorie value to bread.

If there is widespread failure of the potato crops in Great Britain and Europe we may be faced with the problem of supplying vitamin C to a large number of people. The plant available for synthesizing vitamin C in Great Britain may be insufficient to supply our own people in such circumstances. The total requirement for vitamin C from all sources for the population of Britain is about thirty tons a year, although it is doubtful if even half this amount is actually consumed. A smaller amount still would be required just to protect the population from frank scurvy. Most of this could probably be obtained from natural sources even if there were no potatoes available, provided equitable distribution of these foods could be obtained. We should be able, however, to offer little help to Europe if there were any serious widespread deficiency of vitamin C there, unless we increased considerably our plant for synthesizing this vitamin. Fortunately, the chances of a pan-European potato failure are not very large, although there may be extensive local shortages. The situation might be met in part by the storage of orange, lemon and grape-fruit concentrates.

In conclusion, we may say that the immediate dietary deficiencies liable to be encountered in post-war Europe can be met if appropriate quantities of wheat, dried skimmed milk, dehydrated butter, whale oil, soya beans, dried meat and fish, vitamin A and D concentrates, synthetic vitamin C and/or citrus fruit concentrates are stored.

It has obviously not been possible in an article of this length to discuss all the ramifications of such a proposal, but at least it has been possible to formulate the problem and to indicate the solution.

[1] Widdowson, E. M., and Allington, B. K., *Lancet*, **241**, 361 (1941).

POTABLE WATER FROM SEA-WATER

By DR. A. PARKER

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THE possibilities of obtaining potable water from sea-water by some simple method suitable for use on lifeboats and in similar circumstances have been much discussed during the last few months in the daily Press and in other quarters. Some of the statements made and the opinions expressed have indicated lack of knowledge of the scientific and practical aspects of the problem and of the possibilities and impossibilities. In some instances the statements seem to be of obscure origin and to be reminiscent of the wonderful claims of alchemists of former times. There have been references to a mysterious method of obtaining half a glass of drinking water by adding tablets of undisclosed composition to sea-water. In the circumstances, it seems to be desirable to direct attention to some of the possible methods of removing salt from sea-water to produce potable water, and to indicate their limitations.

Composition of Sea-Water

To understand the problem it is necessary in the first place to know the concentration and nature of the salts in sea-water. Analyses of numerous samples have shown that the composition of the mixture of dissolved salts in the waters of the open sea is practically the same in all parts of the world. Though the composition of sea salt varies little from one sea to another so far as the principal constituents are concerned, there is an appreciable variation in the concentration, apart from the effects of local dilution by inflowing rivers or by melting ice. In general, however, the concentration of the salts in the open sea lies between 32 and 38 parts by weight in 1,000 parts of sea-water, and for the purpose of this article a salinity of 35 parts per 1,000 parts can be taken as an approximate average. An artificial sea-water can be made up by dissolving the following salts in distilled water containing some carbon dioxide and then diluting the solution to give a total volume of 1 litre : sodium chloride, 27·2 gm. ; magnesium chloride, 3·8 gm. ; magnesium sulphate, 1·6 gm. ; calcium sulphate, 1·3 gm. ; potassium sulphate, 0·9 gm. ; calcium carbonate, 0·1 gm. ; magnesium bromide, 0·1 gm. The weights given all refer to anhydrous salts. True sea-water also contains very small quantities of phosphates, silicates, and compounds of nitrogen, and traces of compounds of other elements. The main points, however, are that the concentration of the salts in sea-water is about 35 parts per 1,000 parts, and that nearly 80 per cent of the salt is sodium chloride.

In most of the hard waters used as sources of public water supply in Great Britain, the concentration of the salts in solution is not more than about one hundredth of the concentration of the salts in sea-water ; the salts in hard water are mainly the bicarbonates and sulphates of calcium and magnesium which are easily removed by chemical precipitation, whereas sodium chloride cannot readily be removed completely by simple chemical precipitation. It is thus clear that the problem of removal of salt from sea-water is much more difficult than that of softening ordinary hard water. At the same time, it should be mentioned that it is not necessary to remove the whole of the salt from sea-water to produce potable water. Most people would consider that water containing not more than 0·8 part by weight of sodium chloride in 1,000 parts is not too unpleasant for drinking ; but to reduce the salinity of sea-water to this value means removing more than 97 per cent of the salt. In some circumstances it may be satisfactory to drink water containing as much as say 4 parts of salt in 1,000 parts, but to reduce the salinity of sea-water only to this value would require the removal of nearly 90 per cent of the salt.

Treatment

Distillation. An obvious method of obtaining drinking water from sea-water and one which has long been used in certain parts of the world for considerable quantities of water is to boil the sea-water and to cool and condense the steam evolved. With evaporators or stills able to produce 5–20 tons of distilled water a day from sea-water, and of simple design and without elaborate equipment to conserve heat, there is no difficulty in obtaining 6–7 tons of distilled water for each ton of coal or oil burnt. If

the equipment is designed and operated greatly to reduce the losses of heat by radiation and convection from the evaporator and condenser, and to recover heat from the steam, 9–10 tons of distilled water and even more can be obtained for each ton of fuel consumed. To obtain this greater efficiency requires more elaborate and costly equipment and more skilled supervision.

The question at once arises as to whether it is practicable to design a small still, which can easily be operated and will utilize the fuel with reasonable efficiency to produce say 1 pint of distilled water an hour. If the still is of simple design so that it is unlikely to fail under difficult conditions, it is improbable that the high efficiencies of some large installations can be obtained. With careful attention to the design of the still and the burner, it may be practicable in some circumstances to obtain five or six volumes of distilled water from sea-water with the combustion of one volume of oil or spirit; this represents an efficiency of heating and evaporation of the order of only 50 per cent. The space occupied by the equipment and fuel, and the weight in relation to the quantity of distilled water produced, are important factors. Investigations are in progress on the possibilities of designing a still and burner suitable for use in lifeboats. It must be emphasized, however, that the conditions to be met are stringent and the difficulties to be overcome are great. There must be no appreciable risk of failure in any part of the still or the burner.

Absorption of Water Vapour. It is possible to obtain drinking water from sea-water by utilizing the property possessed by certain substances such as silica gel of absorbing large quantities of water vapour. If silica gel is exposed over the surface of sea-water, the gel absorbs water vapour from the moist air; this vapour is replaced in the air by the natural evaporation of the sea-water, and the process continues until the absorptive capacity of the silica gel is exhausted. If the gel has been suitably prepared it may take up water vapour equal to about one fifth of its own weight. This absorbed water can be removed by heating the gel, and the vapour so obtained can be condensed by cooling. After heating, the gel can be re-used and the process repeated. In effect, this method is similar to that of simple distillation but is less efficient and presents greater difficulties.

Freezing. It has long been known that drinkable water can be obtained by melting the ice formed on cooling sea-water. As the cooling proceeds, ice separates until the remaining liquid is saturated with the salts; the solid which afterwards forms is a mixture of ice and salt. Though the latent heat of ice is very much less than the latent heat of evaporation of water, it is unlikely with present methods of refrigeration that a simple apparatus could be devised to produce drinking water from sea-water so efficiently as by distillation.

Hydrates. Another possible method is to add to the sea-water salts which dissolve readily when the water is warm and which on cooling the solution separate as crystals containing a considerable proportion of water of crystallization. The crystals can be removed and, on heating, some of these hydrated salts lose water of crystallization as vapour which can be condensed. The remaining de-hydrated or partially de-hydrated salt can then be re-used. Substances other than salts also form hydrates. A method of this kind could not be carried out so simply and efficiently as distillation.

Osmosis and Electro-osmosis. If sea-water is placed in the middle cell of a vessel divided into three compartments by two semi-permeable membranes, and fresh water is placed in the outer compartments, salts slowly diffuse from the middle compartment into the water in the outer compartments. In this way the salinity of the sea-water is decreased.

To bring about any great reduction in the salinity, very large volumes of fresh water must be circulated through the outer compartments. The quantity of fresh water required can be reduced considerably by placing electrodes in the outer compartments and passing current between them so that positive ions such as sodium migrate to one side and negative ions such as chlorine migrate to the other side. Even with this system, which requires a large expenditure of electricity, the quantity of fresh water which must be circulated through the outer cells is much greater than the quantity of sea-water converted into drinking water. This method thus seems to be impracticable.

Chemical Precipitation. It is possible to remove practically the whole of the magnesium, calcium, chloride, sulphate, bromide and bicarbonate from sea-water by the addition of chemical reagents which react with these radicals to form insoluble compounds. For example, addition of lime water precipitates magnesium as hydroxide, and bicarbonate as calcium carbonate; and soluble salts of silver remove chloride and bromide as insoluble silver chloride and silver bromide. There is much more difficulty in removing sodium and potassium, as the simple salts of these metals are all to some extent soluble. Several complex salts of sodium, which are sparingly soluble in water, are the basis of recognized methods of quantitative analysis for sodium. The conditions of precipitation, however, have to be carefully controlled, and some of the best of the precipitating agents are toxic.

Even after precipitation of the various radicals as insoluble substances, the complete separation of the precipitates is not easy, as some of the precipitates are in a finely divided condition and are not readily removed by filtration. Any toxic substances must also be removed if the treated water is to be satisfactory for human consumption. It thus seems that it is not easy to devise a simple method of removal of salts from sea-water by chemical precipitation.

Base-exchange and Acid-exchange. It has been known for a long time that certain aluminosilicates possess base-exchange properties and can remove calcium and magnesium from water. The process has been in use for some years in the well-known household water softeners and on a much larger scale in softening water for public supply and for industrial purposes. The sodium compound of the aluminosilicates is ordinarily employed for this process of water softening. When the hard water is passed through a bed of granules of the sodium compound, the calcium and magnesium bicarbonates and sulphates in the water are replaced by the soluble sodium salts, and the sodium in the aluminosilicate is replaced by calcium and magnesium. When the whole of the replaceable sodium has entered the water and has been replaced by calcium and magnesium, the material is regenerated for further use by treatment with a solution of sodium chloride,

whereby the calcium and magnesium are again replaced by sodium. Though the process softens water, it does not reduce the total quantity of salts in solution.

In 1934, during the course of experiments at the Chemical Research Laboratory, Teddington, for the Water Pollution Research Board of the Department of Scientific and Industrial Research, B. A. Adams and E. L. Holmes[1] discovered that certain synthetic resins possess base-exchange properties. These resins have the advantage over the aluminosilicates that they are insoluble in dilute solutions of acids, such as sulphuric and hydrochloric acids. It was also discovered that other resins with acid-exchange properties can be prepared. By treating saline water with a base-exchange resin, previously regenerated with a solution of sulphuric acid or hydrochloric acid, the sodium chloride in solution is replaced by hydrochloric acid. When this water is treated with an acid-exchange resin, previously regenerated with a solution of an alkali, the hydrochloric acid is removed. In this way the whole of the salts can be removed from the water.

At about the time of the discovery of the exchange resins, several investigators in different parts of the world found that base-exchange material similar in properties to the base-exchange resins can be prepared by treatment of coal with strong sulphuric acid. This material can also be used in conjunction with acid-exchange resins to remove dissolved salts from water. The acid-exchange resins are unique in that no other substances have been discovered with similar acid-exchange properties.

Base-exchange materials and acid-exchange resins are now in use in several parts of the world for the removal of salts from certain waters, not nearly so saline as sea-water, to produce the equivalent of distilled water, and for the recovery of valuable materials from trade waste waters.

In sea-water the concentration of the salts in solution is so great that the volume of the exchange materials required to remove the salts is about the same as the volume of potable water obtained. It may be, however, that investigation will lead to some improvement, though the prospect of considerable improvement within a short time is not great.

It is also possible that further investigation will lead to some practicable method in which the salts are removed partly by exchange materials and partly by chemical precipitating agents. The difficulty is to develop a method which is simple in operation.

Conclusion

It may be that investigations now being made will lead to some practicable method, suitable for use in lifeboats, of obtaining drinking water from sea-water by simple distillation or by the use of base-exchange and acid-exchange materials and chemical precipitating agents. Any method proposed, however, must be submitted to stringent tests before it is recommended, if undue risk of failure with serious consequences is to be avoided.

Meanwhile arrangements have been made to provide lifeboats with larger quantities of drinking-water than has previously been the practice.

[1] *J. Soc. Chem. Ind.*, **54**, 1T (1935); British Patents Nos. 450,308, 450,309, and 474,361, and foreign equivalents; Annual Reports of the Water Pollution Research Board for the years ended 30th June, 1935, 1936, 1937, and 1938 (H.M. Stationery Office).

THE ANTHROPOLOGICAL APPROACH TO THE STUDY OF MUSIC

By F. H. ANGOLD

IN attempting any study of this kind, or seeking to gain some light on the question of the relationship between anthropology and music, it is necessary to define the term music. The dictionary does this in the following terms: "Melody or harmony; any succession of sound so modulated as to please the ear; the science of harmonic sounds, or the art of producing such; rhythmic order."

With this definition in mind we have to realize that the definition was an attempt to explain something already in existence: musical performance preceded the definition of meaning. Music is therefore an attribute of man, apparently as old as man himself. In style to-day it varies as widely as do the characters of the human species. It is not confined to any one particular aspect of man's existence: he gives vent to music on occasions clouded by sorrow, equally as on others which are brightened by seasons of joy. We are led therefore to ask: Why on all occasions does man turn to music as the medium for the expression of feelings which words might prove inadequate to define? The animal is able to give vent to sound, the bird to trill its notes of music; man alone possesses the power to define the gifts with which he is endowed. The music used by man to express his joy or sorrow does not necessarily come exclusively from man himself; he co-operates with Nature. This reminds us of Beethoven who, visiting in after years the place where he composed his fifth and sixth symphonies, remarked to his friend Schindler: "Here I composed the 'Scene by the Brook' and the yellowhammers up there, the quails, nightingales and cuckoos round about, composed with me"[1].

To-day, music like painting is a specialized art: in earlier times it was the gift of all men. There is evidence that Palæolithic man had his music and at least possessed a primitive type of flute made with reindeer horn, while relics of the Bronze Age reveal prehistoric horns made of metal[2].

In modern civilized society the musician, like the painter, performs a particular task; he fulfils the normal functions of man, functions which so far as the majority are concerned have become atrophied through non-use. This development in the history of man has had a diverse effect upon his well-being. It means that while the vast majority may be unable to express their feelings in musical terms, the person devoting himself entirely to musical composition has been able to create a type of music far removed from the crude melodies of more primitive people. This, however, is not the whole story, for we find that the Sumerians and the Egyptians had developed a high standard of musical instruments. A good idea of the type of instruments in use may be gained from the works of Canon F. W. Galpin, Sir Leonard Woolley and C. Engel. We are faced therefore with a musical knowledge of great antiquity[3].

The question arises as to whether harmony was a feature of this ancient music, for in China there is melody but not harmony. We find that the Greeks used a crude accompaniment of drone bass to some of their songs, while Pythagoras about 600 B.C. introduced

ROYAL (DICK) VETERINARY COLLEGE, EDINBURGH

DEPARTMENT OF PATHOLOGY, etc.

Applications are invited for the appointment of Senior Lecturer in the subject of Pathology at this College: the commencing salary would be £475 per annum rising by annual increments of £25 to a maximum of £760, with superannuation benefits.

Applications are also invited for the appointment of Junior Lecturer in Pathology: the commencing salary would be £380 rising by annual increments of £20 to a maximum of £570, with superannuation benefits.

Applications should be lodged, not later than March 16, 1942, with the undersigned from whom further particulars may be obtained. Six copies of the application for the post concerned, together with six copies each of not more than three recent references, will be required.

A. C. DOULL, C.A.
Secretary.

February 7, 1942. Summerhall, Edinburgh, 9.

UNIVERSITY OF BRISTOL

DEPARTMENT OF AGRICULTURE AND HORTICULTURE

Applications are invited for the post of Advisory Entomologist for the Bristol province, under the scheme of the Ministry of Agriculture and Fisheries for the provision of technical advice for farmers. The post is subject to the conditions of tenure and salary of the Ministry with initial salary according to the qualification of the person selected. Duties to commence on August 1, 1942. Application with copies of testimonials and the names of three referees should be sent on or before March 9, 1942, to the undersigned, from whom further particulars can be obtained.

WINIFRED SHAPLAND,
Secretary and Registrar.

MINISTRY OF LABOUR AND NATIONAL SERVICE

REQUIRED FOR EMPLOYMENT IN THE EAST

Vacancies are now open for the following categories of workers for employment in the East:

Category.—Assistant Chemists, partly for laboratory and partly for process plant operation.

Qualifications.—B.Sc. of a recognized University with subsequent plant or laboratory experience.

Age.—Below 30.

Salary.—£450 minimum.

Applications should be made in writing, giving full details of qualifications and with copies of testimonials (not returnable) to: The Secretary, Overseas Manpower Committee, Ministry of Labour and National Service, Hanway House, Red Lion Square, London, W.C.1.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM

THE LABORATORY, PLYMOUTH

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intervals. The five-toned pentatonic scale is the most primitive form now in use among civilized people. This was the form chiefly used by the Chinese even four thousand years ago, and is used in such familiar hymns as "There is a Happy Land," and Scottish songs such as "Ye Banks and Braes"[4]. That this pentatonic scale is of great antiquity in Asia there can be little doubt; it is also interesting to find that the scale in music of Scottish and other Celtic races bears resemblance to the pentatonic scale of the ancient North American Indians[5].

In his book "Science and Music" Sir James Jeans suggests a possible manner by which organs originally designed for registering pressure in water became adapted for registering the pressure of the air, thus becoming associated with sounds and the presence of food and danger[6]. He suggests that as the result of a period of drought the fishes came on dry land (according to the geologists about 300 million years ago), the survivors eventually becoming pure land animals, and incidentally our ancestors. The new functional operation was a gradual development from the old. The illustrations in Jeans's book which are a photographic record of eddies caused by sound and water are full of interest. One shows an eddy formed at the lip of a flute organ pipe, another depicts the eddies formed by drawing an obstacle through still water, while yet another shows the type of eddy formed in water as it streams past a long thin wire. Looking at these photographs I was at once reminded of some of the Chinese landscape paintings 山水 where the water eddies are frequently depicted in a manner almost identical with the illustrations given by Jeans. Such eddies may be seen in the painting "Ten Thousand Li down the River", by Hsia Kuei, a reproduction of which is to be seen in "Chinese Art", by Ashton and Gray[7]. Incidentally, these eddies closely resemble the 'running spiral', a design which figures prominently in ornamental decoration all over the world. It seems probable that science is revealing to the present age things which in remote times were familiar but have long been obscured to the more sophisticated. If, as Jeans suggests, we are the descendants of water creatures which became pure land animals, involving a change in the functional use of our organs, we may have an explanation for the similarity in sound and water eddies. Maybe the Chinese with their greater measure of placidity have been able to keep in mind what we have lost.

The Chinese writer, Lin Yutang, describes music in the following terms: "Music is pure sentiment itself, dispensing entirely with the language of words with which alone the intellect can operate. Music can portray for us the sounds of cowbells and fish-markets and the battlefield; it can portray for us even the delicacy of flowers, the undulating motion of the waves, or the sweet serenity of the moonlight; but the moment it steps outside the limit of the senses and tries to portray for us a philosophic idea, it must be considered decadent and the product of a decadent world."[8]

The question of sound is full of interest. Drums and rattles seem to have been the earliest types of musical instruments; they still figure prominently in the world of music. The hour-glass-shaped drum of China was in use in the Indus Valley early in the third millennium B.C.[9]. It has been suggested that the drum came into being as a means for reproducing the sounds made by the footsteps of walking man[10]. We are all familiar with the use of the drum for military purposes, and the part it plays in keeping men in step on the march.

Music is therefore based on hearing, the modern composer is an individual who possesses the ability of hearing sounds which to the less sensitive ears are non-existent, and of being able to put those sounds on record. Man must have music; the closer man lives to Nature the more musical his life becomes. In music man unites with the other members of creation and, dispensing with words, using a medium common to all creatures, gives vent to sound and in so doing seeks to harmonize with Nature. He becomes a part of that undying flame, of which all through the ages man has been aware but never able to explain—life. We find therefore that modern man is not far removed from his more primitive ancestors. We may listen to some of the crude music of the African, or the weird chants of the Indian; they are expressive. Then we may turn our thoughts to tunes such as "All through the Night", the Welsh tune without words, but one which admirably expresses the night coming over the mountains. As we listen the scene comes up before us. Or take another example, the Irish tune "Londonderry Air", to which there are no proper words. It conjures up a picture of Ireland, soul-stirring to the depths. To-day we are divided into groups. Not only is the composer in a class apart, but the ordinary people are also divided into sections: on one hand, those who are able to appreciate and enjoy music, and on the other, those who are less fortunate. Even these sections are subdivided, for among the music lovers we have those whose interest lies mainly in classical music, while others find complete satisfaction in jazz. In seeking to understand such diversity we are confronted with the fact that it is not always the educated class who appreciate good music, thus introducing the vexatious question of the difference between culture and education. We are also made aware of another fact.

Music, being creative, is therefore of necessity peaceful; warlike music in consequence is anomalous. Music, like painting, transcends the barriers of nationality and race; in consequence it serves as signposts to the path of man's ultimate salvation. The fact that under modern conditions it is the particular interest of the few may help to throw some light upon the tragedy of modern times, and any increasing interest shown by the majority must serve to indicate that man is slowly coming to realize what he has lost. A greater interest can only tend to reveal the truth that man's interests are common the world over, and any attempt to study the relationship of man to music must help to lead men back to the fundamental truth that there is but one race—the race of men.

[1] Thayer, "Life of Beethoven", vol. 2, p. 120; Spencer and Huxley suggested imitativeness of Nature (bird-songs, etc.) as a possible commencement of emotional music ("Encyclopedia Americana", **19**, 624; 1937).

[2] "Encyclopedia Americana", **19**, 624 (1937).

[3] Galpin, F. W., "The Music of the Sumerians"; Woolley, L., "The Sumerians"; Engel, C., "The Music of Most Ancient Nations".

[4] "Encyclopedia Americana", **19**, 624 (1937).

[5] Engel, C., "The Music of Most Ancient Nations".

[6] Sir James Jeans, "Science and Music", p. 3.

[7] p. 204.

[8] "The Importance of Living", p. 145.

[9] Galpin, F. W., "The Music of the Sumerians", p. 70.

[10] Engel, C., "Music of Most Ancient Nations", p. 10.

OBITUARIES

Prof. James Wilson

THE first professor to be appointed to the chair of agriculture in the Royal College of Science for Ireland by the Department of Agriculture and Technical Instruction for Ireland was James Wilson, a Scotsman who, as a student and a young agriculturist, had already won distinction in his native country, and whose death occurred on December 9, 1941. It is now forty years since he delivered his first set of lectures to Irish students, who for a period of twenty years received from him successive courses in technical agriculture and to whom the memory of Wilson will ever remain dear.

He very quickly gained knowledge of Irish conditions and made a special study of the economics of agriculture in the country. Numerous papers on this subject appeared in the *Journal* of the Department of Agriculture and elsewhere. As a result, Wilson's influence soon extended beyond the sphere of the lecture room and in a short time he became a leading figure in the field of Irish agriculture. Naturally, a man of his talent found himself in conflict with certain aspects of agricultural practice, and, consequently, much of his writing was of a controversial nature. He thought independently and wrote forcibly, but his pleasing style and frank exposition won the admiration of his readers, while his erudition commanded the respect even of those with whom he disagreed.

Wilson's greatest contribution was, however, in the sphere of scientific agriculture. He was an ardent student and an untiring worker, and his many publications on the breeding and feeding of farm stock testify to his industry and ability. Most of his scientific work is recorded in the *Scientific Proceedings of the Royal Dublin Society*, in the activities of which he took the keenest interest. He specialized in Mendelian heredity. Among his productions on this and cognate subjects are the following books: "A Manual of Mendelism", "The Principles of Stock Breeding", "The Evolution of British Cattle". Later his attention was directed to stock feeding, on which subject numerous contributions flowed from his pen. The comprehensive volume, "The Principles of Stock Feeding", was his latest big work in this connexion.

As a lecturer and teacher Wilson endeared himself to his students. His geniality was overflowing and his method of imparting knowledge quite fascinating. Formal lectures he disliked: he preferred to converse with his class and a feature of his lecture was that the students talked as much as the professor. His students are now engaged in a variety of agricultural activities where the influence of the teacher will be manifest for many a year.

J. P. DREW.

Mr. Geoffrey Milne

THE death, at Nairobi on January 16, of Mr. Geoffrey Milne, of the East African Research Station, Amani, at the age of forty-three, deprives the world of a most able and experienced investigator of tropical soils. Mr. Milne, who was the brother of Prof. E. A. Milne, Rouse Ball professor of mathematics in the University of Oxford, graduated at the University of Leeds in 1921, to which he returned after a period as agricultural chemist in the University of Aberdeen, to occupy a post in the Department of Agriculture. He joined the staff at Amani in 1928 and quickly earned a reputation in the field of soil geography. It is largely due to his efforts that soil cartography has been unified throughout the East African dependencies and a rational basis established for soil classification. He combined in an unusual degree the qualifications of a geographer and a laboratory worker, and of a theoretical and a practical soil scientist.

Mr. Milne will be remembered chiefly as the editor and principal compiler of the first soil map of East Africa, published in 1936. The map, though necessarily incomplete, introduced many novel features of soil cartography. In particular Milne made use for the first time of the concept of the 'catena', a sequence of several soil types recurring in regular order in association with certain types of topography, usually undulating or hummocky. This marked the formal recognition by soil cartographers that the delineation of type of landscape may be equally important on a soil map as type of soil.

In recent years Milne was much occupied by the urgent practical problems of soil conservation in East Africa, and in 1938 made an extensive tour of the American soil-conservation stations. Afterwards he published a report of his tour that gave an exceptionally vivid picture of the state and organization of soil research work in the United States. At the time of his death, he was about to take up the post of scientific secretary to the East African Supplies Board.

Prof. F. von Müller

PROF. FRIEDRICH VON MÜLLER, emeritus professor of internal medicine at Munich, a brief announcement of whose death appeared in the *Schweizerische medizinische Wochenschrift* of November 29, was born on September 17, 1858, the son of the director of the Augsburg Hospital. After studying medicine at Würzburg and Munich, where he qualified in 1882, he became assistant to Prof. Carl Gerhardt, whom he accompanied to Berlin in 1885. He was afterwards appointed professor of medicine at Marburg, Basle and finally at Munich, where he became director of the Second Medical Clinic.

According to Garrison, who describes him as "perhaps the most scientific teacher of internal medicine to-day", he had one of the most largely attended clinics in Europe. He was well known in Great Britain, where he was elected an honorary member of the Clinical Section of the Royal Society of Medicine in 1933. His first publications were devoted to problems of physiological chemistry, such as the metabolism of albumin, fat absorption, the origin of urobilin, and metabolism in fever and convalescence. Later he directed his attention to various departments of internal medicine, including intestinal intoxication, exophthalmic goitre, Bright's disease and bronchitis. His principal books were a handbook of clinical diagnosis in collaboration with O. Seifert (1886), investigations on two fasting men (1893) and some problems in metabolism and nutrition (1900).

J. D. ROLLESTON.

We regret to announce the following deaths:

Prof. T. Levi-Civita, For.Mem.R.S., formerly professor of mechanics in the University of Rome, on December 29, aged sixty-eight.

Prof. Virgilio Tedeschi, professor of biological physics in the National University of La Plata.

NEWS and VIEWS

Royal Meteorological Society : New President

THE election of Prof. D. Brunt as president of the Royal Meteorological Society will be welcomed by all meteorologists. Prof Brunt received a mathematical training at Cambridge and lectured on mathematics before joining the Meteorological Section of the Royal Engineers in 1916. During the War of 1914–18 his first book appeared, on "The Combination of Observations", which gave a systematic account of the application of mathematics to observational data, especially in meteorology ; it reached a second edition in 1931. After the war ended, he joined the staff of the Meteorological Office as superintendent of Army Meteorological Services, where he remained until 1934. During this period he carried out a great deal of research into periodicity in meteorological phenomena, bringing to the subject rigid mathematical criteria of reality which did a great deal to correct the rather credulous attitude of earlier workers, and disposed of the belief in dominant 'weather cycles'. He then turned his attention to dynamical meteorology and to the fundamental physical properties of the atmosphere, especially in connexion with radiation. In 1934 he was appointed to the chair of meteorology at the Imperial College of Science and Technology, succeeding Sir Gilbert Walker. In the same year he published his well-known text-book on "Physical and Dynamical Meteorology", from which most of the younger generation of meteorologists have received a thorough grounding. He was elected to the fellowship of the Royal Society in 1939. Prof. Brunt has been associated with the Royal Meteorological Society for many years, as councillor, vice-president, editor and as the author of numerous stimulating papers in the Society's *Quarterly Journal*.

Conference on European Agriculture

THE British Association announces a conference on "European Agriculture : Scientific Problems in Post-War Reconstruction", arranged under the auspices of the Division for the Social and International Relations of Science as a matter arising out of the recent conference on Science and World Order. This agricultural conference will be held on Friday and Saturday, March 13 and 14, in the rooms of the Royal Society, Burlington House, London, W.1. There will be morning and afternoon sessions on each day, and British and foreign experts will deal with such subjects as the immediate technical steps necessary for reconstruction, settlement, marketing and prices, farm and factory, nutrition, the co-operative system, land reforms, peasant prosperity, excess population, peasant education, the improvement of peasant farming, livestock problems, artificial insemination, milk production, market gardening, and the relations of European agriculture to world conditions. A regional survey of European agriculture is contemplated, inasmuch as it is felt that many of the problems of reconstruction may be better viewed regionally than within the limits of political divisions. The chair of the opening and closing sessions will be taken by Sir John Russell ; the names of other chairmen and of speakers will be announced when the programme is complete. Further particulars can be obtained from the Secretary, British Association, Burlington House, London, W.1.

Science and World Order

A BULLETIN has been issued by the British Association summarizing action taken and inquiries made by the officers and council of the Association and the executive of the Division for the Social and International Relations of Science, down to the end of January, on matters arising out of the Conference on Science and World Order. *The Advancement of Science*, No. 5 (Pp. 120, 5*s*.), contains a full report of the transactions of the Conference, together with certain related communications received later. A Penguin volume on "Science and World Order", based on the proceedings of the Conference and compiled by J. G. Crowther, D. P. Riley, and Dr. O. J. R. Howarth, is in preparation. On the direction of the Council of the Association, the executive subcommittee of the Division convened a meeting, which included representatives of Government and other bodies interested in building and territorial planning to consider what action, if any, might be desirable on the part of the Association in connexion with this matter. It was decided to form a representative committee, in accordance with a regular practice of the Association, to inquire into and report upon the state of science in relation to building and territorial planning, with the view of summarizing the present position of researches in these connexions and indicating their services.

The executive subcommittee of the Division, on the instruction of the Council, held a meeting, with assessors, to consider what action, if any, should be taken by the Association in relation to post-war university education. It was decided that a committee be appointed with wide terms of reference, as follows : (*a*) To consider the general policy and methods of university education with a view to promoting international collaboration and the free interchange of ideas, and relating university education to the needs and service of the community ; (*b*) to consider the replanning of teaching departments and curricula in accordance with modern conceptions of the interrelations of different branches of knowledge, particularly those of science and the humanities ; (*c*) to survey the position regarding teaching material, apparatus, books and staff in universities which have been damaged, destroyed, disorganized, or closed as a result of the War, and to make recommendations for their rehabilitation. This committee is in progress of formation ; its joint secretaries are Prof. F. E. Weiss and Mr. A. Gray Jones.

Certain further matters have appeared, after inquiry, not to call for action, or at any rate immediate action, on the part of the Association. Thus, the Council has taken no immediate action upon various suggestions, made during and after the Conference, concerning the establishment of an international league of science, and a standing consultative committee representative of British and foreign science in Great Britain. The Council endorsed the view of the executive subcommittee of the Division that the International Council of Scientific Unions and the Unions themselves, if effectively reconstituted after the War, should provide adequate opportunities for international co-operation in science ; and it is understood that discussions to this end are in progress. The Association received a report arising out of proposals for a register of, and meeting-place for, foreign men of science now in Great Britain. It is understood that material exists for a register in the records of the International Labour Department of

the Ministry of Labour and of other organizations; also that another organization is contemplating the provision of facilities which may offer arrangements for periodical meetings of allied scientific workers.

Carrots for Domestic Animals

WAR conditions have established the merits of carrots as an ingredient of the human dietary: that they are no less excellent as a food for farm animals, is shown in a recent article by Mr. H. E. Woodman, of the School of Agriculture, Cambridge (*J. Min. Agric.*, 48, No. 3, 185; 1941). Indeed, all kinds of stock are fond of carrots, and although their importance in animal feeding is overshadowed by that of the other root crops—swedes, mangolds and turnips—this is not due to any inferiority in feeding quality, but rather to price considerations and to the fact that when the human requirements in Great Britain have been met, the supply of carrots left over for animals has usually been quite small. This year it seems there will be a large surplus. On the basis of starch equivalents, 80 lb. of carrots should be able, on an average, to replace 100 lb. of mangolds, or 90 lb. of swedes. With the more watery turnips, however, two parts by weight may be replaced by one part of carrots. Carrots are not so rich as swedes in vitamin C, the anti-scurvy factor, but are distinguished from all other roots by their high content of carotene. Since this yellow pigment is convertible into vitamin A in the body of the animal, it follows that carrots are a good source of this important health factor.

Raw carrots have always been a favourite food for horses. The allowance should not exceed 20 lb. per head per day, but smaller amounts may be fed with benefit to condition. They should be used in partial replacement of oats, 7 lb. of carrots being equal to 1 lb. of the cereal. Dairy cows may receive up to 40 lb. of sliced carrots per head per day and fattening bullocks up to 60 lb. The carotene in the carrots enriches the colour of winter milk and improves its content of vitamin A, and for this reason, carrots are specially valuable when the dairy ration contains neither kale nor silage. They may be used to replace dried sugar-beet pulp (7 lb. of carrots = 1 lb. of dried beet pulp) or cereals (8 lb. of carrots = 1 lb. of crushed barley). Pigs may also be given carrots with advantage to health and condition; and cereal meal, up to one fifth of the total ration, may be replaced by this succulent food, of which 8 lb. should be fed for every lb. of cereal meal replaced. The carrots form a useful source of vitamin A for pigs that are kept entirely indoors. Some authorities recommend cooking or steaming them for pigs, but the full beneficial effect is only obtained when they are fed raw. Grated or shredded carrots, when mixed with the meal ration, provide a palatable and health-promoting feed. Carrots form a useful supplement to the growing and laying mashes of poultry during winter, and their vitamin A potency is particularly beneficial in these cases. They are best fed raw. Grated or shredded carrots may replace cereals up to one fifth of the total mash, 8 parts by weight being used to replace 1 part of cereal.

Carnegie Corporation of New York

IN the report of the president of the Carnegie Corporation of New York, covering the year ended September 30, 1941, Mr. Frederick P. Keppel, who retired from the presidency on November 18, states that of grants totalling 2,706,834 dollars made during the year, 500,000 dollars were allocated for matters relating directly to the national emergency. Special stress is laid upon the importance of timing in enterprises involving effective co-operation between public and private agencies, public offices, and private citizens or groups. Besides contributions to the National Academy of Sciences totalling 100,000 dollars, emergency grants were made to the Institute of Public Administration for special studies undertaken at the request of Government agencies, to Harvard University for training supply officers, to the National Bureau of Economic Research and the Institute of Pacific Relations, as well as to other agencies. Of other grants, 398,511 dollars was allotted for library interests, including support of the *Journal of Documentary Reproduction*, 566,930 dollars for adult education and 906,956 dollars for research and studies. The Committee on Scientific Aids to Learning has steadily proceeded with its work in the fields selected for intensive study, namely, the problems of microphotography, including visual fatigue, and the development of the best visual and auditory equipment for classroom use. From the special fund set aside by Mr. Carnegie for the Dominions and Colonies, 70,000 dollars was allotted for library and educational services in Trinidad and the Windward and Leeward Islands, 30,000 dollars for the research activities of the International Labour Office at McGill University, 14,800 dollars to the Canadian Research Council in the Social Services and 7,500 dollars to the Royal Institute of International Affairs for a study of the internal economy and external relations of Newfoundland; a further grant has also been made to the Carnegie Endowment for International Peace.

Mr. Keppel's report includes a review of developments and changes in the field of activity of the Carnegie Corporation during his nineteen years of office, in which he emphasizes the possibility of a foundation adjusting itself to meet sharply changing conditions if its house is in order financially and otherwise. Its trustees should not only represent financial judgment and experience but also lay opinion, and they should possess a true understanding of the importance of education in a civilized society. He also stresses the value of a closely knit programme in each field of activity, and the necessity of being prepared to withdraw from a field in which the law of diminishing returns begins to operate, and finally the importance of timing, of endeavouring to have the idea, the man and the setting in perfect conjunction: the idea, vital and timely; the scholar or executive at the peak of his powers; and the organization at flood tide.

Rodent Pests in War-time

MR. A. D. MIDDLETON has given some useful information for the control of the rabbit population of Great Britain (*J. Min. Agric.*, 48, No. 2). He believes the best prospects for success depend upon better co-ordination of effort with county pest officers instead of individual efforts at control without co-operative schemes, but that it is unreasonable to commercialize it and to expect a profit from rabbit control. However, the high price of rabbits and the

intensive efforts of gamekeepers and trappers appear to have reduced the rabbit to comparative scarcity over most parts of Great Britain, a position approaching that of the end of the War of 1914–18, when wild rabbits became very scarce. On the other hand, the position of the rat is still serious, and in some 'blitzed' centres and ports with bigger food stores than usual, conditions have encouraged its increase. In an article on rat control (*Lancet*, 1, No. 5, 1942), Mr. Eric Hardy directs attention to the value of asbestos and three-ply wood as rat-proofing materials when many usual materials are unobtainable. White arsenic is the most useful of the poisons permitted by the law. Attention is also directed to the need for using more traps—even ten times as many traps as rats—and to using unbaited traps, and the encouragement of those predatory enemies of rats in the countryside usually destroyed by game-preservation, namely, stoats, foxes, badgers, owls, herons, otters, buzzards and polecats. The Ministry of Food's Infestation Order 1941, which came into force in January, gives added power for compulsory control of rats and other warehouse vermin.

Wood Pigeon Investigation

THE British Trust for Ornithology is organizing a winter wood pigeon investigation in the British Isles which ought to shed much light upon the habits of this serious agricultural pest. Although organized from the natural history point of view, the investigation may well provide information of considerable value in the control of this pest. Explanatory forms and recording cards for field counts and roost positions have been circulated, and the inquiry will also include the examination of crop-contents of shot birds and post-mortems upon diseased birds. The field counts will make observation upon the sizes of the local flocks at every opportunity when they perch, feed, roost or are in flight, and in addition to recording the day and place, the hour of the count will be noted. Record will also be made of their daily feeding, drinking and resting times, and the influence, if any, of fog, mist, rain and increasing daylight, and if special fields are favoured for feeding and resting. Observations will be made to see if the flocks remain intact throughout the day or break up, and if pairing takes place in flocks. The roost observations will count or estimate the number of birds using the roosts, the type of wood, the trees most favoured, the period in use, and whether it is used annually and if the size of the roosting flock is increasing or decreasing. An effort will also be made to get experienced people to weigh, measure and determine the sex of shot wood pigeons. The field counts will be returned to the Edward Grey Institute at Oxford monthly, and the rest of the winter stage of the investigation will be completed by the end of May.

The Swedish Botanical Garden

THE January issue of the *Anglo-Swedish Review* announces that the Bergianska Trädgården or Bergianum, the botanical garden of Stockholm, is to mark its hundred and fiftieth anniversary this year. It was founded in 1791 by Peter Jonas Berg, a doctor of medicine and a botanist, who bequeathed it to the Swedish Academy of Science. It consists of a purely scientific botanical section and a practical section, which in peace-time carries on a large exchange of seeds with most of the botanical gardens abroad. Among the latter is the botanical garden of Tokyo, which had to place considerable orders to complete its collections, part of which were destroyed in the earthquake ten years ago. The Bergianum is also in close touch with the United States, and some plants from the salt steppes of Russian Turkestan recently came from Russian botanical gardens. Most of the seeds received are of purely scientific interest, but sometimes seeds and plants of commercial value are also received. The results of experiments on the effects of the vigorous cold of the last two years on different plants will shortly be published in *Acta Horti Bergiani*, which contains the results of research work in systematics, cytology and embryology. The celebrated collection known as "Iconotheca Botanica Bergiana" contains 10,000 photographs by most of the botanists in the world. A large room in the main building is filled with cupboards which originally belonged to Bergius and contain his collections of plants and insects. Thanks to a donation, the Bergianum will soon have a winter garden where all the flora of the Mediterranean will be grown.

Public Health in India

ACCORDING to the annual report for 1940 of the Public Health Commissioner with the Government of India, there were no abnormal outbreaks of disease in that year, and the common epidemic diseases such as malaria, smallpox and plague had been less prevalent than in 1939. The most important public health event was the third meeting of the Advisory Board of Health at Poona, where reports were made on the compulsory inoculation of pilgrims at festival centres against cholera and on the control of food adulteration. The Board recommended a plan for the provision of laboratories, including for each Province or State a central laboratory, regional laboratories for groups of districts and others for individual districts. The low incidence or complete absence of the common infectious diseases such as cholera, smallpox and plague in the prisons, of which the daily population was more than 13,000, showed the efficacious control of these infections. The report also contained a chapter on medical research, especially on nutrition, by the Indian Research Fund Association, field studies on cholera, plague and malaria, leprosy research carried out mainly at the Calcutta School of Tropical Medicine, and maternal mortality investigated at Calcutta, Bombay, Delhi and Madras. Cerebrospinal fever had occurred in sporadic form in many provinces.

Radio Receiver Design

IN the past few years radio manufacturers in Great Britain have awakened to the fact that the export industry has been very much neglected. This is shown clearly in a paper read before the Students and Graduates Sections of the Institution of Electrical Engineers by Mr. J. H. Lemmon, on "Tropical Receiver Design" (*Quart. J. Inst. Elec. Eng.* of December 1941). In British colonies, the majority of radio receivers in use until about 1938 were of either American or Dutch origin. British manufacturers had sent out to India or other tropical countries receivers which differed very little from those sold in the home market, and little attention was paid to the internal parts of the receiver. Mr. Lemmon takes India as the basic country, since a fairly comprehensive

knowledge of the radio markets there is available. In India, where the transmitters may be many hundreds of miles apart, medium-wave broadcasts are not of very much use, except for local listening-in areas near the large towns. They cater mainly for the local inhabitants and native listeners, and the value of the programme transmitted from one town may be of very little use in an adjacent area. The European listener abroad wants to hear programmes and news from his home country, and for this reason he has to rely on short-wave listening. The most used wavelengths for this purpose are in the 13-, 16- and 19-metre bands, which give reliable services over very long distances for the greater part of the year, while certain other stations work on 30-, 60- and 90-metre bands. The exported radio receiver therefore, in addition to withstanding tropical conditions, should cover all wave-bands from 13 metres to 90 metres, and also medium waves between 200 metres and 330 metres.

Infra-Red Radiation in Industry

A PAPER on "Infra-Red Radiation and Equipment: their Application to Industrial Processes", read recently by Mr. R. Maxted before the Illuminating Engineering Society, emphasizes that the technique of radiant heating depends on direct experiment rather than upon an understanding of wave-length effects, properties of materials, etc., although a knowledge of the spectral characteristics of the materials is necessary if optimum combinations of wave-bands and materials are desired. Transformation into sensible heat is one effect of the absorption of radiant energy, and radiant heating depends entirely upon this effect, the energy absorbed by the material being instantly converted into heat upon exposure to radiation. The incident energy is partially reflected, transmitted and absorbed when any substance is irradiated, the magnitude of each effect ranging throughout the electromagnetic spectrum with any given material. The direct effect of absorption is that energy is re-radiated at longer wavelengths, change of structural state takes place, or sensible heat is produced within the absorbing substance.

Radiant heating is usually employed for dehydration, enamel stoving, or other change-of-state phenomena, and it is believed that the practical results obtained are solely due to heat application and not to any structural change arising from the direct action of radiation. Further developments may conceivably lead to the utilization of spectral effects but present-day practice aims at applying heat. It should be noted, however, that while interest centres in the thermal effects of absorption, the material receiving heat treatment is not necessarily the absorbing substance; an enamelled metal sheet, for example, may be irradiated from the back, or a transparent lacquer may be indirectly heated by absorption in the under surface.

Summer School in Human Biology

DURING the last year, the Educational Advisory Board of the British Social Hygiene Council has arranged, in co-operation with local education authorities in different parts of the country, refresher courses in biology for teachers. These were primarily designed to help to equip teachers with a background of biological knowledge, to undertake, in the schools, courses similar to the School Leaver's Courses proposed by the Board. In several areas teachers attending these lectures have expressed a wish for a further course of practical work, and to meet this demand, and that of other teachers, a summer school in human biology has been arranged to be held in Cambridge during August 5–19.

The school is planned to be of help to teachers in junior and senior schools and the junior forms of secondary schools. Each morning there will be a lecture on some biological topic, followed by practical laboratory work. The practical work will consist mainly of fairly simple experiments and demonstrations of such a nature as to be of use in schools where comparatively little equipment is available. In the afternoons there will be organized excursions to places of interest such as various research laboratories and biological museums and institutes. After tea each day there will be seminars at which practical teaching problems will be discussed, and there will be a display of biological films and textbooks.

Most evenings after dinner will be devoted to lectures, by eminent biologists, on the social implications of biology. Accommodation will be provided in one of the colleges for both men and women. There will be free time in which the members of the school will be able to visit the colleges and other places of architectural and natural interest. Further details may be obtained from the Education Officer, British Social Hygiene Council, Tavistock House South, Tavistock Square, W.C.1.

Food and Nutritional Needs

THE Nutrition Society has arranged a whole-day conference on "Food Production and Distribution in Relation to Nutritional Needs" to be held on February 28, beginning at 10.30 a.m., at the London School of Hygiene and Tropical Medicine. Papers will be read by Sir John Orr ("The Agricultural Implications of a Food Policy Based on Nutritional Needs"), Dr. N. C. Wright ("Rival Claims of Animals and Man for Food"), Mr. E. T. Halnan ("Animals as Food Converters") and Sir John Russell ("Planning for Agricultural Production"). Among those who have agreed to participate in the discussion are Prof. A. W. Ashby, Sir Joseph Barcroft, Mr. A. N. Duckham, Prof. H. D. Kay and Dr. T. F. Macrae. Sir Wilson Jameson (chief medical officer, Ministry of Health) will take the chair at the morning session. Provisional arrangements have been made for further meetings to discuss, among other topics, (1) "The Preparation of Food in Wartime with Special Reference to Collective Feeding" and (2) "Nutritional Requirements for Optimum Health". Further information about the Nutrition Society can be obtained from the Hon. Secretary, Dr. Leslie J. Harris, Dunn Nutritional Laboratory, Milton Road, Cambridge.

The Newton Tercentenary

NEWTON was born on Christmas Day, 1642. The Physical Society will celebrate the tercentenary of his birth by holding a special meeting at which an address will be delivered dealing with the life, work and influence of Newton. The lecturer will be Prof. E. N. da C. Andrade, Quain professor of physics in the University of London. Details of the meeting will be announced later.

LETTERS TO THE EDITORS

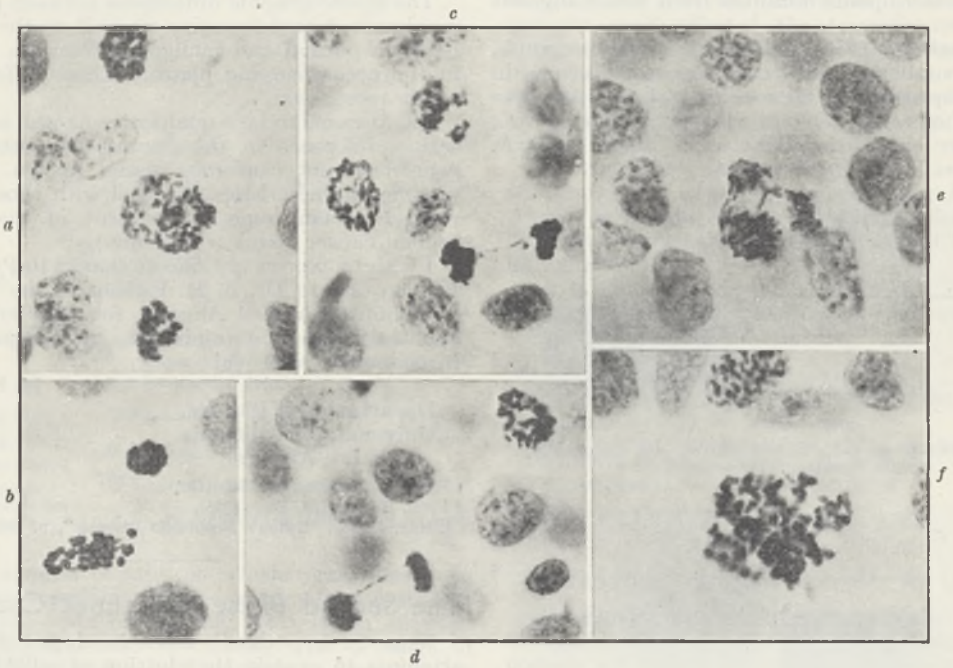
The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

A New Technique for Mitosis in Tumours

IN cancer therapy it is of great interest to distinguish between tumours according to their degree of mitotic activity. This requires a determination of the proportion of dividing to resting cells. It may even be useful to follow the character of mitosis after X-ray treatment. Human cells are difficult to handle for this purpose. The usual techniques are tedious and unsatisfactory. Indeed, misleading conclusions have often been reached owing to the inadequacy of the preparations used. In contrast with the older methods, I find that La Cour's acetic-lacmoid (resorcin-blue) treatment[1] is rapid and, as may be seen from the photographs, capable of showing both the character as well as the stage of division.

The method is as follows. Fix small pieces of tumour in acetic-alcohol (1 : 3) for 10 min.–24 hr. Before staining, cut small shreds of tissue from the surface with scalpel and transfer them into 10 per cent acetic acid for five minutes and 45 per cent for ten minutes. Then stain with warm (40° C.) acetic-lacmoid for 15–30 minutes. Put one drop of acetic-lacmoid on slide with one piece of stained tissue. Crush the tissue by tapping with the blunt end of a bone needle-holder. Remove all unmacerated fragments. Cover and press with blotting paper to spread the cells and remove surplus stain. Heat slide gently without boiling. It is at once ready for study. If required for further use, keep slide 1–5 days in moist atmosphere at freezing point and make it permanent by the usual method[1]. In order to make well-stained permanent preparations, leave tissue in acetic-lacmoid for twenty-four hours. Using the above method, good smear preparations of rat carcinoma and mouse sarcoma have also been obtained.

Fixed tumour tissues can be stored in 70 per cent alcohol, but the best preparations are obtained from freshly fixed material. If the tissue is left in fixative more than forty-eight hours the chromosomes swell and their staining is not satisfactory.



MICROPHOTOGRAPHS SHOWING VARIOUS TYPES OF DIVIDING CELLS IN TUMOUR OF THE CERVIX. MAGNIFICATION 2,300. (MATERIAL WAS KINDLY SUPPLIED BY THE RADIUM INSTITUTE, MANCHESTER.)

(*a*) Two diploid and one tetraploid mitotic metaphase.
(*b*) Abnormal mitotic metaphase in a haploid cell; only 24 chromosomes are present.
(*c*) Delayed separation of two daughter chromosomes at anaphase.
(*d*) Chromatid bridge at mitotic telophase.
(*e*) Tripolar spindle in a tetraploid cell.
(*f*) Highly polyploid, probably octoploid cell in division.

The work is a part of the programme aided by the British Empire Cancer Campaign.

P. C. KOLLER.
Institute of Animal Genetics,
University of Edinburgh.
Jan. 16.

[1] Darlington, C. D., and La Cour, L. F., "The Handling of Chromosomes" (Allen and Unwin, London, 1942).

Fluorescent Lipoidal Spectra of Human Tissue

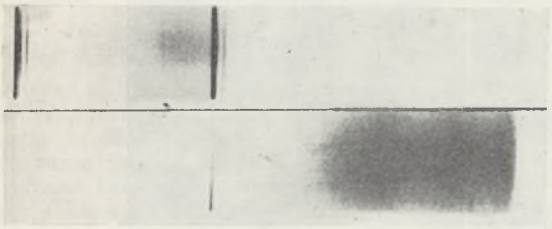
HIEGER[1] pointed out that most of the carcinogenic hydrocarbons studied were highly fluorescent and they produced characteristic bands in the regions 4,000, 4,180 and 4,400 A. The investigation of the presence or absence of similar spectrographic characteristics in non-malignant and malignant tissues was instituted with the end in view that it might shed some light on the presence of possible carcinogens in the latter.

In 1935 I suggested the possibility that "cholesterol or some of its decomposition products" may, under

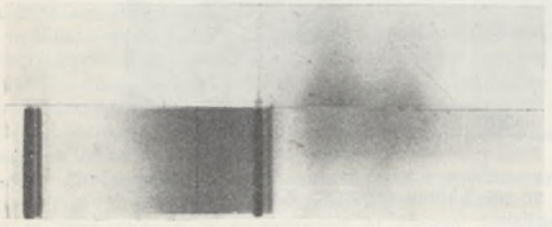
certain conditions, act as carcinogens[2]. Among such compounds methyl cholanthrene is considered "the most active cancer-producing agent known . . . yet the actual presence of any such substances in traumatized tissues has not been demonstrated"[3]. On the basis of the hypothesis of cholesterol carcinogenesis this work dealt primarily with an acetone-soluble lipoid fraction obtained from human cancer tissue.

In connexion with the fluorescence phenomenon it was noted that the cancer tissue lipoids produced a far stronger fluorescence within a given period of time than the lipoids obtained from non-malignant tissue.

The apparatus used consisted of a spectrograph, made by combining a direct-vision spectroscope, in which the spectrum, produced by a glass prism, was photographed with an $f/2{\cdot}5$ camera, a mercury arc, and a filter eliminating light up to about 3,400 A.



FLUORESCENCE OF (*a*) NON-CANCEROUS; (*b*) CANCEROUS TISSUE, PARTIALLY DEPROTEINIZED.



FLUORESCENCE OF (*a*) METHYL CHOLANTHRENE; (*b*) CANCEROUS TISSUE, MAXIMUM DEPROTEINIZATION.

A Pyrex container specially blown to egg-shell thickness, of about 50 mm. in diameter and about 40–50 mm. in depth, was placed with the solution directly under the filter. The spectrograph was placed at right angles to, and about 10 mm. from, the container. It is noteworthy that an empty Pyrex container did not register any fluorescence above 4,047 A.

All tissues used were carcinomata. Briefly, the lipo-proteins were prepared as follows:

Tissue was minced, then ground very finely with sand and extracted alternately with acetone, petroleum ether, and acetone, 250 c.c. of solvent to 100 gm. of tissue. These extracts were pooled, evaporated and then treated with excess acetone to precipitate out the lecithins. The acetone solution was then placed in a refrigerator for forty-eight hours, filtered and evaporated. (This may have to be repeated until residue gives a clear solution in excess cold acetone.)

Other methods, whereby a greater amount of lipo-protein may be obtained from a given quantity of tissue, are being investigated. The results will be published in a subsequent communication.

About 10 c.c. of the lipo-protein was shaken vigorously with 3–4 times its volume of a saturated alcoholic solution of mercuric chloride and allowed to stand about twenty-four hours. To this was added a saturated alcoholic solution of caustic potash until *p*H8 or higher was reached. This was filtered. and the precipitate washed several times with petroleum ether, which was added to the filtrate. The partitioned petroleum ether fraction was then pipetted off, washed again with alcohol caustic potash solution, re-pipetted off, evaporated and the pale yellow lipoid fraction taken up in CP toluene. The resultant solution (about 0·5 per cent) must be clear.

The spectrographic differences between partial and maximum deproteinization as well as the difference between normal and malignant fractions are shown in the accompanying plates. These differences are easily recognized.

There seems to be a qualitative as well as a quantitative difference in the fluorescence between non-cancerous and cancerous tissue lipoids. Spectrographic characteristics identical with those found in methyl cholanthrene are evident in the lipoid of human cancer tissue (carcinoma).

I wish to express my sincere thanks to Prof. Joseph Kaplan and to Dr. S. M. Rubens of the University of California at Los Angeles, for their co-operation and assistance in obtaining the spectrographic data in connexion with this work.

H. S. PENN.

Department of Physics,
University of California
at Los Angeles.

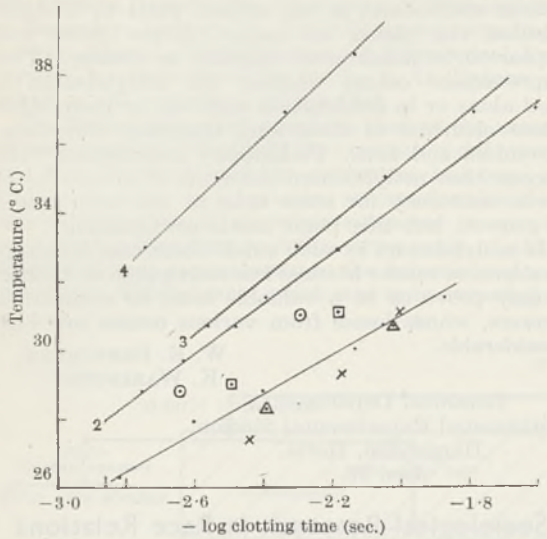
1 Hieger, I., *Biochem. J.*, 505 (1930).
2 Penn, H. S., *Med. Rec.* (1935).
3 Ewing, James, "Ewing's Neoplastic Diseases", p. 106.

The Second Phase of Rennet Coagulation

VARIOUS hypotheses have been put forward in attempts to explain the clotting of milk by rennet. That from the Carlsberg Laboratories[1,2] has probably been the most widely accepted. This theory states that the clot is due to the precipitation of the insoluble calcium salt of paracasein after the enzymic alteration of a constituent of the original casein, which is presumed to behave, before this alteration, as a protective colloid for the other constituents. Thus the coagulation process can be divided into two phases, one enzymic and one non-enzymic. It has been generally agreed that these two phases can be differentiated, but their precise nature has not yet been made clear.

This note is concerned with the second phase, sometimes referred to as the precipitation of calcium paracaseinate[1,3]. This is probably not the simple precipitation of an insoluble salt; for example, it does not occur readily at a low temperature. Effront states[4] that below 15° C. milk is not clotted by rennet, although the enzyme does alter the protein. Most chemical changes, including the majority of enzyme reactions, have a temperature coefficient of 2–4 per 10° C. That this coefficient holds approximately for rennet over the range 37°–0° C. is shown by the fact that the first phase is completed at 0° C. after a definite time which can be calculated from that required at 37° C. For example, a sample of milk which contained sufficient rennet to clot it in eight minutes at 37° C. was kept at 0° C. for 130 minutes ($130 = 8 \times 2{\cdot}12^n$, where $n = 37/10$). Its clotting time at 37° C. was then 90 seconds. Longer storage at 0° C. caused only a slight further reduction of

clotting time. This took place at the rate of seconds only per day. Thus a method is available for separating the two phases of rennet action, and the effect of various factors, such as temperature on the second stage, can be studied.



1. Raw milk, No. 1
2. Raw milk, No. 2
3. Pasteurized milk
4. Reconstituted spray-dried skim milk powder

⊙ No. 2 after 24 hr. at 0° C.
▷ No. 2 after 48 hr. at 0° C.
⊡ No. 2 + N/5,000 $CaCl_2$ after 24 hr. at 0° C.
× No. 2 + N/500 $CaCl_2$ after 24 hr. at 0° C.

Using samples of milk on which rennet has been allowed to complete the first stage of its action at 0° C., it has been found that the relation between temperature and rate of clotting over a range of clotting times from 1 to 9 minutes is described by the equation

$$R_{(T+t)} = R_T e^{kt},$$

where $R_{(T+t)}$ is rate of clotting at $T+t$° C. (1/clotting time in seconds), R_T is rate of clotting at T° C., and k is a constant, the value of which depends upon the milk.

Thus the graph obtained by plotting log rate against the temperature is a straight line. The observed values of k were 0·46 for fresh milk, 0·32 for another milk which had been preserved at 1° C. for a day, 0·28 for pasteurized milk, and 0·25 for reconstituted spray-dried skim milk. These values of k correspond to temperature coefficients $\left(\frac{R_T+1}{R_T} = e^k\right)$ between 1·6 and 1·3 per degree. The only relevant reaction with a temperature coefficient of this order is the denaturation of proteins. That of ovalbumin has a coefficient of 1·9 per degree between 60° and 70° C., while the corresponding figure for hæmoglobin is 1·3 over the same range[5]. It is therefore suggested that the second phase of the coagulation of milk by rennet is a denaturation (unfolding and relinking of polypeptide chains) or partial denaturation of the casein, which has been rendered heat-sensitive by the enzyme.

This hypothesis is supported by the sensitiveness of the reaction to calcium ions. Addition of calcium equivalent to N/5,000 in the milk led to a decrease in clotting time of 18 per cent, and an increase to N/500 caused a decrease of 61 per cent in the clotting time. The temperature coefficient of the reaction was not affected by the presence of added calcium.

A phosphorus-containing protein from malt wort also exhibits this phenomenon[6]. In the absence of calcium, it can be heated under certain conditions for several hours at 100° C. without coagulating, but in the presence of N/200 calcium chloride it coagulates as soon as the temperature reaches 50° C.

Most of the lines in the accompanying graph converge as the temperature diminishes and would meet between 10° and 20° C. if the relation still held. This would mean that the differences between the milk samples used affected the temperature coefficient only, and that therefore, for example, the contents of calcium ion were equal. The fact that a very small quantity of calcium exerts such a large effect suggests that the quantity of ionized calcium originally present is very small.

It is thought that the observations recorded here will provide a means by which many factors controlling milk coagulation may be studied, and that the hypothesis put forward may be of use in such investigations.

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National Institute for Research in Dairying,
University of Reading.

[1] Holter, H., *Biochem. Z.*, **255**, 160 (1932).
[2] Linderstrøm-Lang, *Z. physiol. Chem.*, **176**, 76 (1928).
[3] Brigando, J., *Lait*, **13**, 657 (1933).
[4] Effront, J., "Biochemical Catalysts in Life and Industry", (New York, 1917).
[5] Chick and Martin, *J. Physiol.*, **40**, 404 (1910).
[6] Berridge (unpublished).

Lowland Tropical Podsols in Uganda

RICHARDS has stated[1] that there are indications, though no definite evidence, that lowland tropical podsols are found in Africa. Such soils appear to exist in one small area of Uganda, near Lake Nabugabo, which is adjacent to the north western corner of Lake Victoria (lat. 0° 20′ S., long. 30° 50′ E.). These soils, which are just above the level of Lake Victoria (altitude 1,135 m.), are derived from recent lake deposits of sand. The deposits are poor in bases, like the sands of tropical Asia and tropical America from which podsols have been formed: the poverty in bases is reflected in the composition of the water in Lake Nabugabo, where the alkaline reserve varies between 0·00027 and 0·00029 normal, as compared with the average figure 0·0012 for Lake Victoria[2].

Analyses of the Nabugabo soils are not available and cannot be undertaken at the present time, but there seems no doubt that they must be regarded as podsols; they are very acid in reaction; the surface layers are dark with organic matter and there is a layer of bleached sand in the subsoil. In the hollows well-marked peaty deposits have developed.

Some of the plants in the peaty hollows at Nabugabo have been recorded from other swamps; for example, the tall grass *Miscanthidium violaceum* Robyns, which is common there, is dominant in many swamps in the west of Uganda. Several species, however, have been found in no other locality in the Protectorate. The most notable is *Sphagnum macromolluscum* Dixon, dominant over an area of some acres at Nabugabo but not known to occur anywhere else. Other species of Sphagnum are common on some of the mountains, but there is no

record of them at altitudes below 3,000 m., with the exception of *Sphagnum Franeonii* Warnst[3].

Many species of Utricularia also are found at Nabugabo, among them being *Utricularia appendiculata* Bruce, *U. erecta* Kam., *U. exilis* Oliv., *U. exoleta* R. Br., *U. Kirkii* Stapf, *U. obtusa* Sw., *U. prehensilis* E. Mey., *U. reflexa* Oliv., *U. spiralis* Smith, *U. stellaris* L., *U. subulata* L., *U. Thonningii* Schumach. The genus Utricularia does not seem to be so well represented at any other place in the Protectorate, although some of these species have been found at much higher altitudes on the mountains.

Trichopteryx gracillima C. E. Hubbard is another species recorded from the peat logs of Nabugabo but from no other locality in Uganda. *Drosera Burkeana* Planch. also has been found nowhere else in Uganda, but *D. madagascarensis* D. C., which is more abundant at Nabugabo, is also more widely spread.

The type specimens of several of the species enumerated above have been collected in recent years at Nabugabo and, therefore, it seems probable that similar deposits of peat at low altitudes are not very common in tropical Africa. No other striking examples of lowland podsols have been noticed in Uganda, nor is it to be expected that they would occur: for nowhere else at low altitudes is there the same combination of a climate with a heavy rainfall and of soils made up of leached sands. Eggeling[1] has suggested that at low altitudes in Uganda the Sphagnum community develops only where the natural succession is upset and cites other examples where it has occurred in annually burnt Miscanthidium swamps.

Miscanthidium violaceum is dominant in many swamps in the west of Uganda, and scattered plants of Sphagnum, Utricularia and Drosera are often found in association with it. The soil reaction in these swamps is always very acid but the subsoils, when tested by the chemical section of this department with Comber's reagent, have given a bright red colour, showing that the iron had not yet been leached out.

Crocodiles, which are abundant in Lake Victoria, are absent from Lake Nabugabo. The reason has remained a complete mystery. Lake Nabugabo was formed when a sand spit shut off a bay of Lake Victoria, and at the present time it is separated from the larger lake by a stretch of level ground, only three quarters of a mile wide, which could easily be crossed by crocodiles. Yet no crocodiles have been seen in Lake Nabugabo, although the temperature of the water and the supply of fish would seem to be favourable to them.

It is possible that the water of the lake which, near the eastern shore beside Lake Victoria, has a faint peaty smell and is acid in reaction, may be so distasteful to crocodiles that they avoid it. If this is the case, it is an interesting example of the complexity of the ecosystem, in that the character of the soil has controlled the distribution of so large an animal as the crocodile.

Department of Agriculture, Kampala, Uganda.
Oct. 5.
A. S. THOMAS.

[1] Richards, P. W., NATURE, **148**, 129 (1941).
[2] Worthington, E. B., "A Report on the Fisheries of Uganda" (London, 1932), p. 64.
[3] Eggeling, W. J., *J. Ecol.*, **23**, 430 (1935).

Value of Molybdenum for Lettuce

IN the course of work on the minor element constituents of Chilean nitrate, the value of molybdenum in improving the growth and health of lettuces has been apparent. With one part of molybdenum (as sodium molybdate) in ten million parts of nutrient solution the plants are larger, deeper green and appear to be much more resistant to disease. This improvement occurs whether the molybdenum is used alone or in conjunction with one or more other minor elements as strontium, titanium, vanadium, chromium and zinc. Preliminary experiments even suggest that molybdenum can fend off symptoms of boron deficiency for some time in the early stages of growth, but this point needs confirmation.

If molybdenum in such small doses can definitely be shown to render lettuces less susceptible to disease, it may prove to be a valuable asset to commercial growers, whose losses from various causes are very considerable.

W. E. BRENCHLEY.
K. WARINGTON.

Botanical Department,
Rothamsted Experimental Station,
Harpenden, Herts.
Jan. 26.

Sociological Research in Race Relations

IN the light of some present sociological research in the subject of race relations in Great Britain, may I be allowed briefly to endorse the general arguments advanced by Mrs. Neville-Rolfe in her article on "Biology as a Social Science"[1], and more particularly her paragraph on social biology in education?

So far as my present observations show, popular information in respect to problems of human heredity and human biology in general has barely advanced out of the stage of superstition in many aspects, and much confusion exists over the meaning of various terms of technical or semi-technical usage. Perhaps the most common confusion is in respect to the connotation of the word 'race'. This term is used and accepted quite freely as a synonym for 'nation', 'people', or any other similar concept for which an alternative noun cannot readily be found. There appears to be also a fairly wide and quite unanalysed acceptance of such conceptions as 'national psychology', etc., the logical implications of which are that an individual's cultural or social behaviour is 'inherited' much in the same manner as the colour of his skin. Further mysticisms surround the biological and social implications of the phenomenon of racial miscegenation, and that 'blood' itself fulfils the function less romantically ascribed to the genes is as usual an explanation of heredity as the existence of 'criminal types' and the 'science of bumps'!

The 'etiology' of this core of popular 'knowledge' need not be discussed here. The situation, however, plainly suggests that there has been something seriously amiss in previous educational policy. The moral would appear equally plain. Without a foundation of up-to-date information on such subjects it is not easy to see how the average citizen can face with any clarity the many complex problems that are involved in modern social and political policy.

K. L. LITTLE.

Thorneycreek Cage,
Herschel Road,
Cambridge.
Jan. 31.

[1] NATURE, **149**, 90 (1942).

CLASSIFICATION OF RHEOLOGICAL PROPERTIES

THROUGH the courtesy of Prof. M. L. Oliphant, the British Rheologists' Club held a meeting at the Physics Department, University of Birmingham, on Saturday, January 24. After business proceedings, a discussion on "Classification of Rheological Properties" was introduced by Dr. L. R. G. Treloar, on behalf of the committee of the Club.

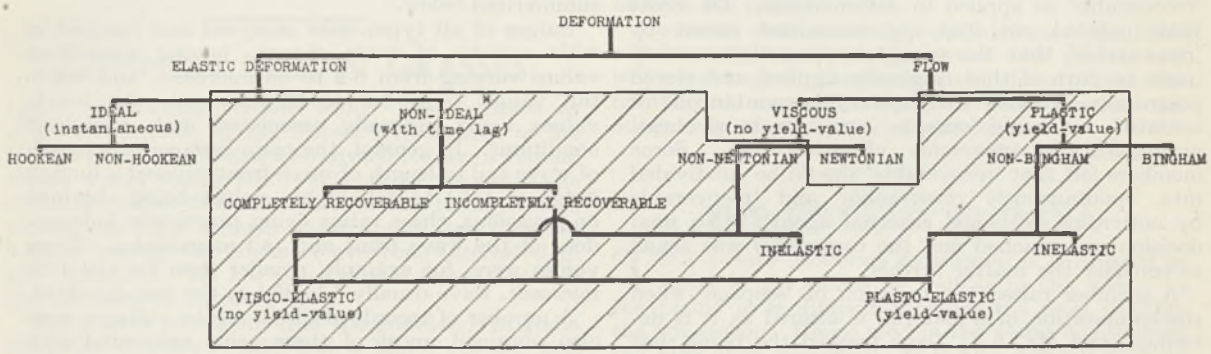
Dr. Treloar reminded members that at the annual general meeting of the Club, the question of definitions had been discussed and the committee had been instructed to draw up a tentative scheme for classification of properties of materials subjected to specific conditions, rather than to define terms many of which might not even approximate to the behaviour of real materials. This scheme, which was to be regarded as preliminary and subject to modification, is shown on the accompanying table.

Deformations are conveniently subdivided into elastic deformations and flow, the former being generally defined as 'recoverable' and the latter as 'non-recoverable'. Recoverable deformations are subdivided into those which are 'ideal', in which a definite strain occurs immediately on the application of a stress, and those which are non-ideal, showing a time lag. Ideal deformations may be Hookean (that is, directly proportional to stress) or non-Hookean. By definition, ideal deformations are completely recoverable, but non-ideal deformations may be either completely or incompletely recoverable. The latter give rise to visco-elastic deformations corresponding to systems which show no yield-value, that is, the smallest applied stresses produce a deformation.

Flow may be viscous (no yield-value) or plastic (yield-value). Here Dr. Treloar stressed the fact that postulating such categories does not imply that it is believed that real materials follow these definitions *exactly*. We need not suppose that any material shows a *perfect* yield-value; still less that there are any perfect Bingham systems in Nature (that is, systems which flow at a rate strictly proportional to the excess of the applied pressure over the yield-value). These categories are of use in giving a practical approximation to the behaviour of real materials.

Deformations which are produced only after a yield-value has been exceeded but which do not obey Bingham's law may be subdivided into inelastic and plasto-elastic; the latter differs from visco-elastic only in showing a yield-value.

Returning to viscous systems which show no yield-value, these may show Newtonian (rate of deformation proportional to stress) or non-Newtonian flow. The latter group subdivides into inelastic and visco-elastic, thus re-merging with the elastic group.



WORKING DEFINITIONS

ELASTIC DEFORMATION—recoverable deformation.

FLOW—non-recoverable deformation.

When flow starts only above a critical stress (YIELD-VALUE) it is PLASTIC. When flow starts at all stresses, however small, it is VISCOUS.

HOOKEAN—obeys Hooke's law, stress proportional to strain.

NEWTONIAN—obeys Newton's law, stress proportional to rate of shear.

BINGHAM—obeys Bingham's law, rate of shear proportional to stress less yield-value.

An elastic deformation is IDEAL when the whole of it follows immediately on the application of a stress. When it does not, it is classed as NON-IDEAL.

NOTE. Categories within the hatched area are liable to change of rate of deformation under constant stress, the rate either increasing or decreasing.

* In the case of a spring and dash-pot in parallel, the system could obey Hooke's law if the stress were applied sufficiently slowly but not if it were applied fast. In some other systems a direct proportionality between stress and strain is not obtained however slowly the stress is applied.

The table should also be extended in another dimension to allow for the fact that, for example, under constant stress, the rate of deformation of many materials accelerates (thixotropy, false body, etc.) or decelerates (work-hardening, dilatancy). Detailed subdivision of these properties has not yet been attempted by the committee but, so that the importance of such properties should not be forgotten, all categories for which such behaviour is not precluded by definition are included in a hatched 'frame'.

Dr. Treloar concluded by expressing the hope that members would criticize this table freely both with respect to suggested alterations and additions.

Dr. G. W. Scott Blair, honorary secretary of the Club, said that he thought members ought to know how much the committee owed to Dr. Treloar for his contribution to the preparation of the table. He had only one other point to make, namely, that those who worked in specialized fields would doubtless find the table still inadequate in the special

parts which concerned them. For the present, a number of phenomena which are known to exist have been omitted since they are not of great practical importance, and it is hoped for the present to keep the table simple. Thus, just as rate of deformation can increase or decrease at constant stress, so the partial differential of strain with respect to stress can likewise increase or decrease with stress considered at any given time. This would necessitate a second frame and a further subdivision of the 'non-ideal' category, but the committee believes that this is best not included for the present.

Mr. van Someren suggested that it would be helpful if each category could be considered in turn, and suggestions offered by members (not for inclusion in the table) of materials which would, under specified conditions, approximate in their behaviour to the category in question. This was done, though in some cases the suggestions were tentative.

There was some discussion on the meaning of 'recoverable' as applied to deformations. Dr. Scott Blair pointed out that the committee meant by 'recoverable' that the energy causing the recovery must be part of that originally applied and stored potentially, whether the recovery is spontaneous or initiated by some outside agent such as heat, mechanical or supersonic vibration, etc. Some members felt that 'recoverable' should be subdivided into 'spontaneously recoverable' and 'recoverable by activation by some external agent'. No final decision was reached and the committee was asked to consider the matter further.

A member raised the question of 'seepage' when the composition of a material is altered as it is deformed, and Mr. J. C. Gage pressed the point that many complex properties such as thixotropy, false body, dilatancy, etc., have not yet been dealt with in the classification. Dr. Scott Blair said that the committee was grateful for such comments and would bear them in mind, and Dr. V. G. W. Harrison asked that members should express freely any views they might hold, especially about any important omissions in the table.

Mr. van Someren pointed out that, at the top of the table, elastic deformations appear on the left and flow ('liquid') properties on the right; whereas at the bottom, the plasto-elastic deformations, implying yield-values, a property of solids, are now on the right, and the visco-elastic on the left. The committee might consider some slight modification of the table by which this apparent anomaly might be avoided.

Mr. Maunder Foster stressed the importance of the adhesive properties of many materials, and gave some account of the significance of this group of rheological properties in the boot and shoe industry.

Dr. T. L. Ibbs, who had presided during the meeting, concluded by saying that, as a non-rheologist, he appreciated the simplicity of the table. It was easily understood by those who were not highly specialized in rheology, and he, for one, hoped that this simplicity might be maintained.

Following the discussion, it was unanimously resolved to accept the table of classification as a basis for further discussion.

Dr. G. W. Scott Blair then read a paper on "Rheological Developments Past and Present", illustrated by lantern slides. A number of members also showed apparatus and materials of rheological interest.

G. W. SCOTT BLAIR.

INVESTIGATIONS ON LIGHTNING IN NIGERIA

IN a recent paper entitled "The Measurement of Lightning Voltages and Currents in Nigeria, Part 2, 1938–1939", read in London before the Institution of Electrical Engineers, F. R. Perry, G. H. Webster and P. W. Baguley record the details of an investigation on the magnitude of lightning voltages and currents on Nigerian high-tension transmission lines, and continue an earlier work commenced by one of the authors. Three-phase oscillographic and klydonographic records of voltages were obtained, together with magnetic link measurements of currents on pole and lattice-mast structures. In addition, continuous records have been obtained of the interchange of current between earth and atmosphere during weather disturbances. The investigation resulted in a large amount of data for statistical analysis, and the results derived are briefly summarized below.

Surges of all types were analysed and resulted in wide variety of wave shapes, having wave-front values varying from 0·2 to 65 microsec., and wave-tail values from 0·9 to 93 microsec., the lowest values being generally associated with flash-over conditions. In general, the ratio between the length of wave tail to length of wave front covered a limited range of 1·2/1 to 4/1, higher values being obtained on occasions, these ratios being practically independent of the wave front and tail magnitudes. These values were, for example, smaller than for the 1/50 microsec. wave usually adopted as the test standard.

A number of records of direct stroke voltages were also obtained, most of these being associated with power system faults caused by line insulation flash-over. In such instances, the complete sequence of events was not always apparent, but it has been found that the recording of voltages on all three conductors is preferable to single-phase recording, a more complete history of the phenomenon being obtained. In two cases, it was found possible to obtain wave-shape records of the constituent strokes of multiple-stroke flashes, resulting in evidence of the family resemblance of such strokes. Certain aspects of the oscillographic records of lightning voltages were confirmed by klydonograms, the data obtained from the latter, however, being less accurate, and, in general, not so complete.

Current measurements were made in the case of direct line strokes, the line in this instance being supported by tubular steel poles, and in addition, the current distribution in the members of a lattice structure was obtained; of these, one set of such measurements involving eighteen lattice masts still awaits analysis.

Pronounced double pulses were obtained in certain oscillographic records of lightning voltages, and the suggestion is made that these are dependent on the current pulses in the main return lightning stroke, as was the opinion of Malan and Collens. Many of the observations made at Kew have been confirmed by observations made by means of a point-discharge recorder, certain differences relating to storm activity being simultaneously revealed with a contrast between temperate and tropical zone storm conditions. It was apparent from these records that a more complicated form of a Simpson-Robinson storm model could advantageously be applied to the task of explaining point-discharge records of lightning phenomena.

Following upon an analysis and discussion of the

data obtained, certain suggestions are made as to the lines upon which future investigation should be conducted, and it is suggested that a study should be made of the voltages produced by multiple-stroke flashes to transmission lines, and an attempt made to ascertain whether any relationship exists between voltage pulses and the predicted currents fluctuating in lightning return strokes. It is further suggested that these data could be got most efficaciously by combining photographic studies obtained by a Boys camera with simultaneous oscillographic records of the corresponding lightning surge voltages. Sudden fluctuations in the point discharge current magnitudes might easily be obtained by means of a cathode ray oscillograph, and synchronized records taken of the discharge current at two or more points situated on the storm track axis, and spaced about 3 miles apart. If the power lines should run at right angles to the storm, then the additional discharge points could advantageously be located along the line.

COMMON INDIAN GRASSES

AN interesting volume which was "written at the request of the Forest Department of the United Provinces, India, who wished to have a manual which would enable forest officers to recognize the common grasses found in their forests, taungyas and plantations" has a much wider appeal and deserves a place among the books of everyone interested in the Gramineæ. Its low price should help to give it the diffusion it deserves*.

The author points out that the grasslands of India are what Tansley would call a biotic climax, and only exist and are maintained when there is a harmony between the climatic and biotic factors so as to prevent the formation of forest. As a consequence, forest officers need to regulate the grazing and burning of the grasslands under their management with care, since too little of either is as harmful as too much.

After a summary of the ecology of the grasslands of the United Provinces, the author briefly discusses the morphology of the Gramineæ and gives short but precise instructions for making detailed examinations of specimens. Two keys are included, the first being an artificial one dealing mainly with larger and more obvious characters and intended for the less specialized user. The second is based on C. E. Hubbard, and contains keys to all the genera and species with which the book deals, except that no key is included to the genera of the Maydeæ (possibly by an oversight) so that the user is not given a clue to the position of Chionachne and Coix. The author might have been bold and included them in the Andropogoneæ, since they are, as Bews says, little more than a sub-tribe of the former.

The rest of the work consists of descriptions of the species common to the United Provinces arranged alphabetically under the genera, each species having two descriptions, one of a more 'popular' type and the other of a more detailed technical character. The known and possible economic uses of each species are briefly mentioned. The ninety-two commonest grasses are described and the work is illustrated with sixty-four plates, most of the species being illustrated either by photographs of living plants or full-page drawings which show clearly their habit and more essential features, a task which is not at all easy with the grasses. The illustrations of Saccharum are especially good, though in some of the other genera a few more detailed illustrations of spikelet dissections would have been welcomed.

A number of small points detract from the work. Phraseology of the type "a feature which is made use of in separating these species", "The nodes are easily made out", "anker roots" (all on p. 19) and "Many species of the Andropogoneæ are collections of spike-like branches" (p. 20) tend to jar the reader. Again, the use of the word Gramineæ without its capital initial, twice in the introduction and occasionally elsewhere is not acceptable, especially as the author has no good reason for this and restores its capital later in the work. A number of plates have the bottom half an inch folded up as they are too large for the volume. This could have been avoided in most cases by a more careful placing of the figures, or even the titles.

However, these are only small defects: the book will be useful to anyone concerned with grasses and will provide good illustrations and descriptions of a number of most interesting tropical grasses not adequately treated in most text-books.

B. C. SHARMAN.

*Common Grasses of the United Provinces. By N. L. Bor. (*Indian For. Rec.*, New Series. Botany. 2, No. 1.) Pp. vii+222+64 plates. (Delhi: Manager of Publications, 1941.) 9.14 rupees; 15*s.* 6*d.* net.

THE POTATO IN INDIA

THE potato (*Solanum tuberosum*) is cultivated in India in the plains as well as in the hills. In the plains it is difficult to store the crop through the hot season. Hence seed in the plains comes from the hills or is imported. It is also difficult to hold potatoes in the plains in storage for table purposes owing to shrivelling, moth attack, wet and dry rots, high-temperature rot and sprouting. Potatoes after lifting will not sprout during a dormant period varying with temperature, variety and maturity at harvest.

Dr. D. V. Karmarkar and Mr. B. M. Joshi began experiments on the cold storage of the Indian potato in 1936, and their results are now published in Miscellaneous Bulletin No. 45 of the Imperial Council of Agricultural Research. The work was done under the Council's cold storage research scheme at Ganeshkhind Fruit Experimental Station, Kirkee. Below 35° F. dormancy was indefinitely prolonged. At 40° F. the maximum period of dormancy observed was nine months. Delay in placing potatoes at this temperature after harvest reduced the period of dormancy. There was no wastage at 40° F. or 35° F., but at lower temperatures, 30° and 32° F., the potatoes were injured after three months exposure. The injury was a blackening of the central tissues (black-heart).

The sprouting vigour of potatoes was not affected by extending the dormant period at 35° or 40° F. The growth and yield of crops grown from seed long stored at these temperatures may even be favourably affected. Black-hearted potatoes merely rot when used as seed.

This report, of which the main results are quoted above, is a sound piece of systematic scientific survey work of permanent value. It provides bed-rock data for agriculture and industry under Indian conditions, such as can only be acquired by years of organized effort. It is to be hoped that work of this character will be continued and extended.

FRANKLIN KIDD.

FORTHCOMING EVENTS

(Meeting marked with an asterisk is open to the public.)

Monday, February 16

JOINT MEETING OF TECHNICAL SOCIETIES ARRANGED AT THE REQUEST OF THE MINES DEPARTMENT (in the Lecture Hall, Public Libraries, Sheffield), at 3 p.m.—Discussion on the Best Ways and Means of Promoting the Efficient Use of Fuel and Power in existing Industrial Plants under Present Conditions, and for Making Constructive Suggestions. (To be opened by Dr. R. J. Sarjant, Mr. H. C. Armstrong and Mr. Donald Wilson.)

Wednesday, February 18

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Sir John Russell, F.R.S.: "Post-War Agriculture in Great Britain".

INSTITUTE OF CHEMISTRY (LONDON AND SOUTH EASTERN COUNTIES SECTION) (at 30 Russell Square, London, W.C.1), at 4 p.m.—Prof. F. A. Paneth: "Artificial Radioactivity and the Completion of the Periodic System".

Thursday, February 19

CHEMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. H. J. Emeléus: "Fluorine".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Mr. John Henry Gorvin: "Some Aspects of the Post-War Feeding of Europe".*

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 6 p.m.—Mr. J. M. Meek: "The Electric Spark".

Friday, February 20

ASSOCIATION OF APPLIED BIOLOGISTS (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 11 a.m.—Symposium on "Domestic Entomology".

APPOINTMENTS VACANT

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

TEACHER OF PHYSICS (MAN OR WOMAN)—Principal, and Organizer of Further Education in Rugby, College of Technology and Arts, Eastlands, Rugby (February 20).

WATERWORKS ENGINEER AND MANAGER—The Clerk to the Southport and District Water Board, Town Hall, Southport (March 7).

ADVISORY ENTOMOLOGIST for the Bristol province, under the scheme of the Ministry of Agriculture and Fisheries for the provision of technical advice for farmers—The Secretary and Registrar, Department of Agriculture and Horticulture, University, Bristol (March 9).

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

National Institute of Industrial Psychology. Annual Report and Statement of Accounts for the Year ended 30 September 1941. Pp. 16. (London: National Institute of Industrial Psychology.) [191

Transactions of the Institution of Chemical Engineers. Vol. 18, 1940. Pp. v+147. (London: Institution of Chemical Engineers.) [191

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 2, No. 14: Chironomid Larvæ of the Millport Shore Pools. By T. A. Stuart. Pp. 475–502. 3*s.* 6*d.* Vol. 60, Part 2, No. 15: The Life-History and Ecology of the Salmon Gill-Maggot *Salmincola salmonea* (L.) (Copepod Crustacean). By G. F. Friend. Pp. 503–542. 4*s.* 9*d.* (London and Edinburgh: Oliver and Boyd.) [231

Leicester Museum and Art Gallery. 37th Annual Report to the City Council, 1 April 1940 to 31 March 1941. Pp. 16. (Leicester: Leicester Museum and Art Gallery.) [22

University of Leeds: Department of Coal Gas and Fuel Industries, with Metallurgy. Report of the Livesey Professor (D. T. A. Townend) for the Session 1940–41. Pp. 24. (Leeds: The University.) [22

Other Countries

Radiations from Radioactive Cobalt: a Dissertation in Physics presented to the Faculty of the Graduate School in partial fulfilment of the requirements for the Degree of Doctor of Philosophy. By Arthur S. Jensen. Pp. 8. (Philadelphia: University of Pennsylvania.) [91

Carnegie Corporation of New York. Report of the President and of the Treasurer for the Year ended September 30, 1941. Pp. xi+148. (New York: Carnegie Corporation of New York.) [91

U.S. Office of Education: Federal Security Agency. Pamphlet No. 80: Sources of Visual Aids for Instructional Use in Schools. Revised edition. Pp. iii+91. (Washington, D.C.: Government Printing Office.) 15 cents. [91

Proceedings of the United States National Museum. Vol. 91, No. 3121: The Mammalian Faunas of the Paleocene of Central Utah, with Notes on the Geology. By C. Lewis Gazin. Pp. 54. (Washington, D.C.: Government Printing Office.) [121

Publications of the Observatory of the University of Michigan. Vol. 8, No. 11: The Julius F. Stone Spectroheliograph for the Determination of Solar Atmospheric Radial Velocities. By Robert R. McMath. Pp. 141–147+7 plates. (Ann Arbor, Mich.: University of Michigan.) [112

U.S. Department of Agriculture. Miscellaneous Publication No. 424: A Classification of the Scale Insect Genus *Asterolecanium*. By Louise M. Russell. Pp. 322. 45 cents. Technical Bulletin No. 791: Hibernation of the Corn Earworm in South-eastern Georgia. By G. W. Barber. Pp. 17. (Washington, D.C.: Government Printing Office.) [121

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 29: The Chemical Processing of Indian Cotton Materials, Part 1: The Effect of Kier Boiling and Bleaching on the Cuprammonium Fluidity and Strength of Yarns spun from Four Good Quality Indian Cottons. By Nazir Ahmad, M. U. Parmar and K. Venkataraman. Pp. ii+18. (Bombay: Indian Central Cotton Committee.) 8 annas. [121

India Meteorological Department. Scientific Notes, Vol. 8, No. 95: Forecasting Monsoon Rainfall in Mysore. By V. Doraiswamy Iyer and C. Seshachar. Pp 117–130. (Delhi: Manager of Publications.) 10 annas; 1*s.* [121

Contributions to Embryology. Vol. 29, Nos. 170–186. (Publication No. 525.) Pp. 193+57 plates. (Washington, D.C.: Carnegie Institution.) 4.50 dollars. [121

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 141: A Soil Survey of the Waikerie Irrigation Area, South Australia. By R. I. Herriot and E. J. Johnston. Pp. 44. (Melbourne: Government Printer.) [191

U.S. Office of Education: Federal Security Agency. Bulletin 1940, No. 2: Statistical Summary of Education, 1937–38. Prepared by Emery M. Foster. (Biennial Survey of Education in the United States. Chapter 1.) Pp. ii+40. 10 cents. Bulletin 1941, No. 1: Educational Directory, 1941. Pp. iii+52+52+130+78. Bulletin 1941, No. 3: Weekday Classes in Religious Education conducted on Released School Time for Public-School Pupils. By Mary Dabney Davis. Pp. vi+66. 10 cents. (Washington, D.C.: Government Printing Office.) [201

Union of South Africa: Department of Agriculture and Forestry. Science Bulletin No. 225 (Botany and Plant Pathology Series No. 2): Some Leaf-Curl Diseases in South Africa: (1) Leaf-Curl Disease of Tobacco, (2) A New 'Petunia'-Strain of Leaf-Curl and a Note on the Occurrence of a Leaf-Curl Disease of Hollyhock. By A. P. D. McClean. Pp. 70. (Pretoria: Government Printer.) 6*d.* [271

Ministry of Agriculture, Egypt: Plant Breeding Section. A New Wheat Variety "Mabrook". By Dr. J. Philp. Pp. 5. (Cairo: Government Press.) [271

Field Museum of Natural History. Botanical Series, Vol. 20, No. 4: Tropical Marine Algae of the Arthur Schott Herbarium. By Prof. William Randolph Taylor. (Publication 509.) Pp. 85–104+2 plates. 15 cents. Geological Series, Vol. 9, No. 1: The Aplodontoidea. By Paul O. McGrew. (Publication 510.) Pp. 30. 15 cents. (Chicago: Field Museum of Natural History.) [271

Ella Sachs Plotz Foundation for the Advancement of Scientific Investigation. Eighteenth Annual Report, 1941. Pp. 6. (Boston, Mass.: Huntington Memorial Hospital.) [271

University of Bombay: Department of Chemical Technology. Annual Report, 1940–41. Pp. iv+27. (Bombay: University of Bombay.) [271

Classified List of Smithsonian Publications available for Distribution, December 1, 1941. Compiled by Helen Munroe. (Publication 3645.) Pp. iv+42. (Washington, D.C.: Smithsonian Institution.) [301

Proceedings of the United States National Museum. Vol. 90, No. 3107: Revision of the North American Moths of the Family Oecophoridae, with Descriptions of New Genera and Species. By J. F. Gates Clarke. Pp. 33–286+viii+48 plates. (Washington, D.C.: Government Printing Office.) [301

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 849–C: Geology and Ground-Water Resources of the Balmorhea Area, Western Texas. By Walter N. White, Hoyt S. Gale and S. Spencer Nye. (Contributions to the Hydrology of the United States, 1940.) Pp. iii+83–146+plate 11. 15 cents. Water-Supply Paper 849–D: Underground Leakage from Artesian Wells in the Las Vegas Area, Nevada. By Penn Livingston. (Contributions to the Hydrology of the United States, 1940.) Pp. iii–147–173+plates 12–17. 10 cents. Water-Supply Paper 866–A: Geology of Dam Sites on the Upper Tributaries of the Columbia River in Idaho and Montana. Part 1: Katka, Tunnel No. 8, and Kootenai Falls Dam Sites, Kootenai River, Idaho and Montana. By C. E. Erdmann. Pp. v+36+7 plates. 25 cents. Water-Supply Paper 868–A: Investigations of Methods and Equipment used in Stream Gaging. Part 1: Performance of Current Meters in Water of Shallow Depth. By C. H. Pierce. Pp. iv+35+27 plates. 55 cents. Water-Supply Paper 868–B: Investigations of Methods and Equipment used in Stream Gaging. Part 2: Intakes for Gage Wells. By C. H. Pierce. Pp. iv+37–75+plates 28–31. 15 cents. Water-Supply Paper 871: Surface Water Supply of the United States, 1939. Part 1: North Atlantic Slope Basins. Pp. xiii+603+1 plate. 75 cents. (Washington, D.C.: Government Printing Office.) [22

Catalogues

Calendar for 1942. (Newcastle-upon-Tyne: C. A. Parsons and Co., Ltd.)

Azozol for the Shock (Convulsive) Treatment of Schizophrenia. Pp. 2. (Nottingham: Boots Pure Drug Co., Ltd.)

A Catalogue of Books and Periodicals on Entomology and General Natural History. (No. 595.) Pp. 32. (London: Bernard Quaritch, Ltd.)

General Catalogue of Books. (Catalogue No. 659.) Pp. 92. (London: Francis Edwards, Ltd.)

The Colorimetric Determination of Oxidation-Reduction Balance. Third edition, revised. Pp. 22. (London: The British Drug Houses, Ltd.)