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THE UNIVERSITY OF ORISSA

DURING the first decade of this century, mainly as the result of the recommendations of the Curzon Commission culminating in the Universities Act of 1904, the older Indian universities, Madras, Bombay, Calcutta and the Punjab, modified their examination requirements and effected fundamental alterations in the teaching in their affiliated colleges. Unfortunately, the university examinations in their various grades from the matriculation upwards continued to be recognized as qualifications for admission to the various Civil Services, since only for a few appointments, such as those in the Finance Department, was there a special Civil Service examination. The linking of the Civil Services with the universities has had the unfortunate result of overcrowding the colleges with students, in many cases of mediocre ability, and has so to some extent nullified the beneficial effect of the improved courses of study. Two other factors have also contributed to still further overcrowding : first, the continued though welcome spread of primary and secondary education, and secondly, the increasing desire for a training in the methods of science.

This increasing demand for higher education has resulted in the opening of a large number of new institutions of university rank throughout the Indian Empire. Unlike the older federal universities, the majority of these new universities have been of the unitary teaching type, as exemplified in the University of Lucknow. At the same time, the older universities have in all cases made themselves directly responsible for much of the post-graduate teaching.

In 1938 the Government of Orissa recognized the necessity of reorganizing the higher education in the Province, and it appointed a representative committee under the chairmanship of Pandit Nilkantha Das to examine the question of establishing a university in the Province. This committee presented its report* last June, and it unanimously recommends that a university of a modified affiliating type should be established. It is suggested that the university should in the first instance be purely affiliating, but that it should later be responsible for the post-graduate teaching. The administrative structure recommended for the new university is very similar to that of the University of Madras.

While many may regard it as somewhat retrograde to establish a new university of the affiliating type, it must be borne in mind that Orissa is a small and not too well-endowed province. The principal college of university standing is the Ravenshaw College at Cuttack, and this will be the

* Supplement to the *Orissa Gazette*, July 4, 1941.

nucleus of the teaching university. It would, however, scarcely be economic if the teaching centres at Parlakimedi and Berhampur were to be closed down. From the figures given in the Committee's report, it is clearly not anticipated that the number of university students will be large, the estimated size of the intermediate classes in arts and science combined being about 400 students, and although there is to be a Faculty of Law, there is no provision for the teaching of medicine. It is refreshing to note that the Committee recognizes that teaching is not the sole function of a university, but that facilities should also be available for original work both in arts and science. It is not unnatural that the Committee should recommend that the post-graduate teaching in Oriya history, language and literature should receive special consideration. We trust that the new university will soon be opened and be making its own contribution to learning.

ORIGIN OF LANDSCAPE FEATURES

Landscape

As Developed by the Processes of Normal Erosion. By Prof. C. A. Cotton. Pp. xviii + 302 + 45 plates. (Cambridge: At the University Press, 1941.) 21*s*. net.

WITHIN the last two decades there has been in Britain a marked revival of interest in the study of landscape features. The subject of geomorphology, even in its more limited scope as applied to the understanding of the surface features of the earth, has attracted new workers both from the fields of geology and geography, and fresh methods of investigation have been devised. The study of erosional geomorphology represents perhaps the most important common ground between geology and geography. In the past geologists have varied in the emphasis which they have laid on the study of 'physical geography', but until recently they have treated it mainly as part of an introductory course; lately there has been a greater tendency to regard it as representing a more important branch of that subject, and to recognize that future progress in the investigation of landscape must depend on workers whose geological training has brought them some acquaintance with the methods of investigation needed for these fields of inquiry.

Prof. Cotton, who has written this latest volume on landscape features and their origin, is in no doubt as to the place of this study. "Notwithstanding the close relation of the study and description of the natural landscape to geography", he trusts that geologists will accept this account "of the elementary principles of geomorphology as a contribution to the literature of their science". For he stresses the fact that the development of land forms has followed as a corollary of earlier geological events, while an understanding of geomorphic processes is essential for the interpretation of geological history. It may perhaps also be added that a real appreciation of the geological time-scale is necessary if landscape features are to be understood and correctly related to one another.

In this volume Prof. Cotton has not attempted to cover the whole field of land forms: he has limited himself to those features developed by the processes of "normal erosion". This he takes to include the results of atmospheric weathering (predominantly chemical) combined with downhill transportation of rock debris, mainly by rain and running water. These processes develop 'normal' landscapes. He regards as special agencies those which depend on climate, whether arid or glacial, and on marine erosion, the effects of which are confined to the land margins. While this limitation enables the author to deal more adequately with the processes which have modified the earth's surface over the widest areas, it has some disadvantages, for since the development of the present land surfaces began there have been great changes in the distribution of climatic regions, and it would be impossible to describe the landscape features of many regions, especially in the northern hemisphere, in terms of normal erosion. This is, of course, fully recognized by the author, and he has found himself compelled to refer to some of the features due to more special agencies.

Geomorphologists owe a great deal to three American pioneers, Gilbert, Powell and W. M. Davis; Prof. Cotton acknowledges this indebtedness not merely by the dedication of his book to their memory, but also by many references to their work and opinions. This must not be taken to imply that the book is formal, or lacks up-to-date references: it presents an original and comprehensive account of the results of normal erosion, differing in outlook and emphasis from other books of similar scope, and dealing with the landscape of regions in all parts of the world.

Probably this wide choice of less familiar examples will be one of the most fruitful features of this volume, particularly since the illustrations lend such a distinction to the writing. For Prof. Cotton has supplied more than two hundred text-figures; most of them are new and many are beyond praise. His 'block-diagrams' are particularly successful, and convey the relation between structure and surface features in a way that will stimulate the geological student and will make the book doubly useful to those untrained in structural work. But these admirable figures do not exhaust the illustrations provided, for there are also forty-five plates, most of them with two photographs, showing a wide range of features; these are chosen from all parts of the world, and their value is increased by the inclusion of many original views of New Zealand.

The sequence of chapters is somewhat unusual: after an early chapter on mass movement of waste there is a study of rivers, their deposits and related phenomena, which occupies fourteen chapters. Then comes a chapter on peneplains and one on resurrected fossil land surfaces. Two chapters on the effects of uplift and warping and the movement of base-level are followed by three very interesting chapters on fault features, block-faulted landscapes, and fault scarps, the book concluding with a short account of limestone landscapes.

In view of recent discussions, British geomorphologists will turn with particular interest to the chapter on peneplains, where the old-age stage of the cycle of erosion is discussed and illustrated. A somewhat fuller treatment of the peneplain problem would have been acceptable. If, as is generally agreed, many areas present us with a stage in the dissection of an uplifted erosion surface, it may be suggested that the study of such surfaces and their relics is of fundamental importance. It is interesting, however, to read of W. M. Davis' explanation of the limiting steepness of the slopes on a peneplain, given a quarter of a century ago: the slopes were such that one might lay out a straight road on the peneplain in any direction, "and trot on it". In these days, comments Prof. Cotton, this would be a 'high-gear' road. He gives British workers some notion of perspective, perhaps, by limiting his reference to British peneplains to some five lines and three footnotes: since so many problems are presented by the erosion surfaces of this small region, notwithstanding the many investigators, it may be felt that some caution is advisable in interpreting some larger and less accessible peneplains.

The production of such an elegant volume, attractively illustrated and on admirable paper, at this time, with the author resident in New Zealand, calls for the warmest congratulations both to him and to the Cambridge University Press. The publication is the more noteworthy since the volume deals with matters of which most must long remain within the province of 'pure' science. The book may be strongly recommended for reading by students of geology and geography, and it should find a place in the libraries of universities and schools.

A. E. TRUEMAN.

TEACHING OF PHYSIOLOGY

Starling's Principles of Human Physiology
Eighth edition, edited and revised by Prof. C. Lovatt Evans; the chapters on the Special Senses revised by Prof. H. Hartridge. Pp. x+1247. (London: J. and A. Churchill, Ltd., 1941.) 32*s*.

Physiology for Pharmaceutical Students
By Dr. Harold Hayden Barber. Second edition. Pp. x+526. (London: Baillière, Tindall and Cox, 1941.) 15*s*.

STARLING's "Principles" first appeared a generation ago, and throughout the intervening years it has been the main vehicle for the diffusion of trustworthy and co-ordinated physiological knowledge throughout the English-reading world. Since Prof. Lovatt Evans has been in charge of the work, it has retained the full treatment of the chemical and physical basis of physiology for which the earlier editions were noteworthy; he has dealt more fully with problems of integration and has kept well abreast of contemporary developments, which are presented in a lucid and balanced manner and with adequate, but not superfluous, documentation.

In the current eighth edition, the physiology of the central nervous system has been completely rewritten to incorporate recent advances such as those dealing with the intricacies of nervous transmission in the spinal cord, and to convey generally the current attitude; newer work in such active fields as the endocrines, vitamins, urinary secretion and metabolism is fully considered. The sections on reproduction and on the special senses (the latter written by Prof. H. Hartridge) are especially noteworthy.

The book, however, is still growing in size, and Prof. Evans will soon have to face the problem which many American writers feel they can safely ignore, whether there is not an optimum size which should not be exceeded for a standard text-book. Most books are written to serve an audience, and texts on human physiology are mainly read by students and practitioners of medicine who want a survey of the subject which can be studied and mastered in the limited time at their disposal. Physiology and the related sciences are expanding at a great rate; before the War, some ten thousand papers appeared annually, which contained new contributions great or small. The author of the standard text-book has the arduous responsibility of sifting this work, of incorporating the outstanding advances, of conveying the changing outlook of his subject, and of directing attention to the chief growing points and to the guiding generalizations which are emerging.

But this does not exhaust the list of the text-book writer's responsibilities; it is still a matter for dispute whether medicine is a science or an art, but undoubtedly the practitioner of medicine must be a man of science as well as an artist. It is essential therefore that at some stage in his education he should be given a sound grounding in the methods and outlook of science. The physiologist may be forgiven for saying that no other subject in the medical curriculum is better adapted than his own for such a high purpose. Enough time is available in the course to deal with some aspects of the subject in sufficient detail to show their historical development. Rigid experimental and observational proofs can be described and carried out in the laboratory of the main theses of the subject. The student may be shown how experiments are planned and carried out and how conclusions are drawn. It may be stated without offence that a good physiological course will make a medical man passably immune to the pitfalls of loose thinking and to the acceptance of inadequately confirmed claims. In addition, however, physiology is one of the principal limbs of the tripod on which clinical medicine rests. Much of the evidence on which human physiology draws is derived from observations and experiments on patients, and to that extent physiology is none other than medicine.

If the text-book is to be kept within manageable limits, the author will not attempt to summarize, ever more briefly, unintelligibly and uninterestingly, the ever-growing mass of material with which he is confronted. He will select his material with the aim of giving the basis of the scientific training, of presenting adequately the fundamental facts and principles of his subject, and he will enlarge especially on aspects of vocational value to the medical practitioner. Observations on man which are scientifically satisfactory must replace increasingly observations made on the lower animals. When human material is inadequate, stress will be laid on observations made on the higher animals. One can see these tendencies now in the treatment of such problems as control of respiration, erythropoiesis, muscular exercise, functions of the higher levels of the brain, secretion of urine, nutrition, and metabolism, to select but a few examples at random. As Prof. A. V. Hill has remarked, teaching is an experimental science, and the abilities of authors will be taxed to the full in the future if their writings are to prove of maximum advantage to the reader.

Dr. Barber's book is obviously meeting a need, as a second edition has been called for in four years. It resembles closely in content and treatment the smaller physiological manuals intended for medical students, except that the nervous system is dealt with very briefly, the special senses are omitted, diet and metabolism are touched on lightly, though a relatively detailed account is given of the vitamins and endocrines. There is also a short section on the elementary pharmacology of some special substances.

Physiology forms part of the course of instruction and of the examination for the elementary qualification for chemists and druggists and for the higher qualification of pharmaceutical chemist. One and two years respectively are allotted for the study of pharmaceutical chemistry, pharmacognosy, pharmaceutics, forensic pharmacy and physiology. As the time available for physiology even in the longer course is very limited, one supposes that physiology has been introduced into the curriculum (especially in the shorter course) mainly for cultural reasons. It is proper that a man who will deal with the preparation and marketing of remedies for human ills should have some general idea of the working of the human body. The physiological training is not vocational because the pharmacist should have few if any opportunities of making practical use of his physiological knowledge, unless he allocates to himself the function of an immature healer and adviser on minor maladies.

Though Dr. Barber's book is so full of facts and figures, chemical reactions and experiments, it does not seem to give the elementary student who is pressed for time a co-ordinated simple account of the workings of the human body. Inadequate attention is devoted to explaining fully and carefully the fundamental principles of the subject. These failings are probably the result in large measure of the existence of a rigid examination syllabus for this group of students, which if it were followed conscientiously by teachers in planning their lectures would make their course no better than a caricature. Thus the 1927 syllabus for the elementary qualification of chemist and druggist refers specifically to "properties of cardiac, striated and unstriated muscle, the mechanism of the heart valves, the coronary circulation, the effect of inflow and rate on the output of the heart, the importance of the maintenance of the blood pressure". There are references to blood, glands of internal secretion, the alimentary tract and food, but so far as this syllabus is concerned the body would appear to possess, among others, no respiratory system, no nervous system, no sense organs, no kidney and no urine. By 1941 the syllabus had gained references to the principles underlying biological assay, but in the meantime the body had specifically lost the anterior pituitary, parathyroids and the organs of reproduction.

It is difficult to say what useful purpose a syllabus of this singularly unbalanced character can serve. In the universities it will no doubt be ignored and a general elementary course based on cultural consideration will be given. In the many less experienced centres that train students of pharmacy, attempts may be made to use the examination syllabus as a basis of teaching, with the result that the course in physiology will be of negligible value. The student reading for the qualification of pharmaceutical chemist needs no special manual, and could safely be entrusted with the shorter works intended for medical students. The more elementary student needs a really straightforward and fully explanatory work which will enable him to see the workings of the body in outline and as a co-ordinated whole. If the present syllabus in physiology for elementary students of pharmacy were completely jettisoned, a considerable advance would be made in the proper training of such students.

Samson Wright.

IMPACT OF INVENTIONS ON PEOPLE

Technology and Society

The Influence of Machines in the United States. By S. McKee Rosen and Laura Rosen. Pp. xiv + 474. (New York: The Macmillan Company, 1941.) 12*s*. 6*d*. net.

We are repeatedly told by those who look beyond the passing events chronicled from day to day that the structure of human society is changing with a rapidity hitherto unimagined, that the world after the War will be a completely different world from that which we knew before. In this there is probably a large measure of truth, but though the War has undoubtedly speeded up the rate of change, the change was inevitable for other reasons. It is explained by the march of technological invention. 'March' seems an inadequate word to describe what has taken place during the brief lifetime of the present older generation—it is rather a flight which leaves one breathless. There is no more ruthless, but—if wisely directed—ultimately beneficent iconoclast than invention, no more powerful lever for moving nations out of the deep ruts of habit and convention into which, if left lethargic, they tend to sink. We are being so lifted and shaken now, and it is as well to realize what is happening if we are to profit by the experience.

In spite of its somewhat deterrent title to those who are not mechanically minded, anyone unfamiliar with the less common inventions of recent times will gain much useful information by studying this book: it is both readable and stimulating. In an introductory chapter Prof. W. F. Ogburn gives an admirable summary of modern discoveries, stressing the imperative need for a national policy wisely shaped in the light of their probable future trends. Naturally he has the United States in mind, but the lesson is one we also might well learn. Attention is directed to the amazing advance of science since the beginning of the century as illustrated by six industries in which development has been great, based upon the invention of the telephone, motor-car, aeroplane, motion picture, rayon and radio. He recalls that round about 1900 Theodore Roosevelt was commended for "his characteristic courage" upon riding in an automobile; forty years later there is one car to every five persons in the States. In 1903 a distinguished American man of science went so far as to surmise that mechanicians would be "ultimately forced to admit that aerial flight is one of that great class of problems with which men can never hope to cope". One particular group of comparatively modern inventions deserves note, although it has been regarded by the authors, no doubt justifiably, as outside their domain: it only receives passing mention. Devices for controlling conception are gradually being perfected. The conspicuous effect of these discoveries, for better or worse, on the trend of world population is now generally recognized, and they are perhaps destined radically to influence family life, the very texture of civilized society.

A major achievement of modern technology is the possibility of continuous production, but such continuity is profitless if there is no effective demand which can be equated to the supply of goods produced. For demand to be effective wages and prices must be suitably related, and here the Government, by its ultimate control over the creation of credit and the conditions of labour, has a responsible part to play. This aspect of the problem is not discussed by the authors. They do, however, point out that machine production, though it involves an initial displacement of labour, should eventually make possible a big increase in sales by reduction in price, and so result in a net gain in employment. Electric light and power, the manufacture of cars, and newspaper publishing are cited as industries where this has actually happened. But everybody does not benefit. Figures are quoted showing that, while annual production per man rose by 39 per cent in the United States between 1920 and 1935, the index of employment fell by 18 per cent. This dilemma could be partly met by continued education, earlier retirement for the elderly, and increased leisure for all, in preference to enforced total idleness for so many. Because such a solution has not yet been adopted, the progress of invention is frequently regarded by the workers with dread. Instead of raising their standard of living, as it should do, it condemns a considerable number to a bare maintenance on charity or the dole. Nor is it only the wage-earner who stands to suffer. We read of company managers who, fearing the adoption of new machines by their trade rivals, do their best to block the marketing of improved models. Commercial competition is not always in the public interest, as is revealed also by the story of national broadcasting in the United States.

But here again there are signs of improvement. Among thinking people there is a steadily growing realization of the essential interdependence of all sectional interests, both within the State and in the wider world. Selfish individualism must give way to "the idea of the general welfare as the basis of public policy." To put this principle into practice demands a sensitive handling of groups, which unfortunately is comparatively rare. In this connexion the description given of the development of the Tennessee Valley Authority is instructive. Created by Congress in 1933 as a public corporation, it possessed at the same time the flexibility and initiative of a private enterprise. Its function was to plan and develop the Tennessee Valley, and its express policy was to use existing agencies wherever possible. The resulting growth of "inter-governmental co-operation attuned to regional needs" is said to have been most impressive. It is clear that success in this case was largely due to appreciation of the importance of the right psychological approach to the various bodies concerned. If we go to work along similar lines, in Great Britain as in the United States, there should be good hope for the future.

D. CARADOG JONES.

NEUROLOGY FOR STUDENTS AND PRACTITIONERS

Diseases of the Nervous System

Described for Practitioners and Students. By Dr. F. M. R. Walshe. Second edition. Pp. xvi+325. (Edinburgh: E. and S. Livingstone, 1941.) 12*s.* 6*d.* net.

THE first edition of this book appeared in September 1940, and the fact that a second edition has been needed within a year (this edition was published in August) speaks for itself. Dr. Walshe planned this book for the use of practitioners and medical students; and there can be no doubt that he has been entirely successful in his object. The need of just such a book as this has been long felt by those engaged in teaching students the fundamental elements of neurology, and those of us who are familiar with Dr. Walshe's powers of lucid exposition and his critical faculty will not be surprised by his success.

Though some important additions have been made in the present edition, the book has retained its original character and purpose. The additions consist of some thirty or so pages and a number of excellent photographs and diagrams which have added materially to the usefulness of the book.

The book is planned in two parts, the first dealing with the fundamental groundwork involved in the correlation of observed physical signs and symptoms, with their physiological and anatomical counterparts, the second being devoted to a descriptive account of the more common diseases of the nervous system. The additions to the first part consist of a brief statement of the tissue reactions occurring in nervous diseases, and some amplification of the section dealing with the organization and symptomatology of sensory, visual and speech functions.

In Part 2 the chapter on intracranial tumours has been partly recast, and additions have been made to the chapters on acute infections, injuries to the head and spine, and lesions of the spinal nerves.

In the preface to the first edition, Dr. Walshe emphasizes the fact that he has written a book which shall deal only with what is possible in general practice, and so warns the reader that he will find little about such things as ventriculograms or of the electro-encephalogram—as the general practitioner will not be required to make or interpret either. That is no doubt true at the present time, but I think that in a future edition for which, if I am not mistaken, there will be a demand before very long, a short chapter on the possible usefulness particularly of the electro-encephalogram might be added with advantage. Mention, too, might be made of the dramatic success which sometimes follows the use of deep X-ray therapy in some cases of post-herpetic neuralgia, not only of spinal type also in some cases where the Gasserian ganglion has been involved. Rather fuller description might with advantage be added to the clinical picture of severe head injuries and to their treatment, for this is a subject of common occurrence and the cause of much anxiety to practitioners and friends alike.

Dr. Walshe has included in his book a chapter on the psychoneuroses, dealing mainly with their diagnosis. In the preface to the first edition he has commented on this in phraseology so apt that I feel I must quote him here: "It may appear unduly sanguine to hope to give within the compass of a single chapter a useful account of this very important aspect of medicine when we recall what a vast literature has grown up around it in the present century. However, much of this is concerned with hypothesis, and the essential task of diagnosis, the clinician's first task, has usually been a Cinderella at this carnival of literary expansiveness." In this chapter is contained a note on so-called 'traumatic' neurosis, a subject on which, as the author says, a candid statement is long overdue. I do not remember seeing in any other text-book of neurology any emphasis laid on the fact that trauma *per se* does *not* cause neurosis. Judging from a considerable experience in courts of law, it would seem that judges, lawyers and medical men giving evidence think that 'traumatic' neurasthenia is as much an entity as measles. It is high time that they became better instructed.

Useful chapters are included in the book on bromide intoxication (a condition which is so often unrecognized) and some general observations upon the treatment of nervous disorders in which what can and what cannot be hoped for are candidly set out. The book ends with an excellent and simple scheme for the examination of the nervous system.

I can recommend the book to the student and practitioner alike in the sure confidence that they will both profit from a study of it and also obtain considerable pleasure in the process.

C. M. HINDS HOWELL.

THE STUDY OF LYMPH

Lymphatics, Lymph and Lymphoid Tissue

Their Physiological and Clinical Significance. By Prof. Cecil Kent Drinker and Dr. Joseph Mendel Yoffey. (Harvard University Monographs in Medicine and Public Health, No. 2.) Pp. x+406. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1941.) 4 dollars.

THIS book is good reading since it shakes convictions and stifles beliefs; and, exposing our ignorance, it will stimulate research. The first chapter is coldly anatomical, but warm argument soon begins. In the second chapter, the authors have to consider the permeability of capillaries in order to account for the composition of tissue fluids and lymph. Here there is difficulty with the albumins and globulins often present in lymph: it is agreed that they are derived from the plasma of the blood, but how do they leak out of the capillaries? The stand is taken that they pass through the endothelial cells under a pressure of a few centimetres of water: but can molecules having molecular weights of many thousands enter, pass through, and emerge from the cytoplasm of endothelial cells where equally large molecules are abundant? If this be the way, there ought to be differential filtration, the smaller albumin molecule passing in greater abundance than the globulin, and yet, as the authors show, the ratio is approximately the same in lymph and plasma. The other way is between the endothelial cells, where there is discontinuity in structure between cytoplasm and intercellular matrix, surely a likely place for leakage. When we come to the passage of these proteins into the lymphatics from the tissue spaces a further difficulty arises: here there is no positive pressure to help the passage, and so some easier way than through the cytoplasm of the endothelial cell of the lymphatic vessel seems especially to be required.

Such interesting questions as these are excellently dealt with in the first 150 pages of the volume.

The rest of the volume deals with the function of lymphoid tissue and of lymphocytes. Lymphoid tissue composes about one per cent of the human body: it is a tissue especially well developed in mammals, and yet we do not know its function. The situation is unique: here is the physiologists' Cinderella.

It is a pleasure to record that this mystery remains the subject of hot debate and a playground for the investigator.

The fate of lymphocytes which enter the blood stream from the lymphatics is of interest. In the case of a dog of 10 kgm. about five thousand million enter the blood stream, via the thoracic duct, per day, sufficient to replace the circulating lymphocytes twice. Where do they go? Many possibilities are considered, but one, I think, has been somewhat overlooked. Not only do lymph glands produce lymphocytes, they also destroy them in large numbers by phagocytosis by macrophages. Perhaps production does no more than equal destruction; if so, the fate of great numbers would be accounted for, as well as a means of maintaining constancy in numbers.

In dealing with the effect of X-rays, the authors have missed an important finding. If a rat be given a very small dose of X-rays the lymphocytes fall to about 50 per cent: if then a second small dose be given no further fall occurs: if one waits until numbers have returned to normal, then a second dose produces again a 50 per cent reduction. There are therefore two kinds of lymphocytes in the rat: measurement of size shows that it is the small lymphocytes which are susceptible and the large resistant to X-rays. It seems possible that results might be more easily interpreted if we separated the large from the small, instead of considering them together. Advance has often been kept back by improper classification.

The final section of the book is entitled "Practical Considerations", and will be of special interest to pathologists and clinicians. Here such subjects as œdema, hypertension, shock, lymphatic obstructions and anæsthetics are discussed from the points of view of the lymphatic system.

J. C. MOTTRAM.

CHROMOSOME CHEMISTRY AND GENE ACTION

By DR. C. D. DARLINGTON, F.R.S.
John Innes Horticultural Institution, Merton, London

THROUGHOUT plants and animals the cell nucleus has a uniformity of structure corresponding to the uniformity of its work. This structure has to reconcile the mechanical requirements of cell division and reproduction with the physiological requirements of heredity and development. Its primary importance has led to its study by a great variety of physical and chemical techniques ; indeed, a greater variety than has been brought to bear on any other type of structure. Differential staining, X-ray diffraction and X-ray destruction, double refraction, micro-dissection, micro-incineration, ultra-violet spectroscopy and differential digestion as well as bulk analysis and the vast magnifications of genetic experiment have been used. They have all played their different parts in the solution of the problem.

The important agents are few and well defined. The nucleus consists of chromosomes which are enormously extensible protein fibres shown by digestion[1] to resemble the protamines and histones making up the bulk of sperm heads[2]. To these fibres, or rather to specific points on them, the chromomeres, are attached desoxyribose-, or thymo-, nucleic acid which is responsible for the specific aldehyde reaction given by the chromosomes in Feulgen's test[3]. Underlying the cycle of mitosis and cell-division is a cycle of attachment and detachment of this nucleic acid to and from the chromosomes. This goes with the cycle of coiling and uncoiling of their protein framework. The maximum attachment corresponds with the maximum spiralization of the chromosomes at metaphase of mitosis. At the other extreme, within the resting nucleus, they are uncoiled and relatively free from nucleic acid[4].

At the end of every mitosis the chromosomes give up their nucleic acid charge and at the same time secrete *nucleoli* which dissolve at the beginning of the next mitosis when the chromosomes are taking up nucleic acid again. These nucleoli contain no thymo-nucleic acid, but instead the ribose form which is characteristic of cytoplasm and of viruses.

The two nucleic acids differ only in the central sugar radical of the nucleotide. The desoxyribose radical apparently, however, gives its nucleotides a flatness to which they owe their capacity for polymerization. They form columns of plates which, as shown by polarized light, lie crosswise to the protein thread[5]. These plates agree in spacing at 3·34 A. with the extended polypeptide chain of the chromosome. It is this capacity which seems to make thymonucleic acid indispensable in the reproduction of the chromosome. For reproduction takes place by division of each fibre into two at the end of the resting stage, when the attachment of the nucleic acid charge is beginning[6].

The chromomeres, photographed by ultra-violet light, have been shown in a simple case to correspond with the units of X-ray breakage, which provide the physical definition of a gene[7]. Among chromomeres three special kinds of structure and function are found (Fig. 1). First there is the *centromere*, the movements of which control the movements of the chromosome on the spindle. The centromeres reproduce, or at least divide, not within the nucleus, but on the mitotic spindle. This delay in their reproductive cycle goes with a deficiency of nucleic acid at all stages of mitosis. If undivided lengthwise they will split crosswise on the spindle. They are, therefore, compound genes[8]. They may be regarded as spindle organizers playing a similar part to the centrosomes although living within the nucleus instead of outside it.

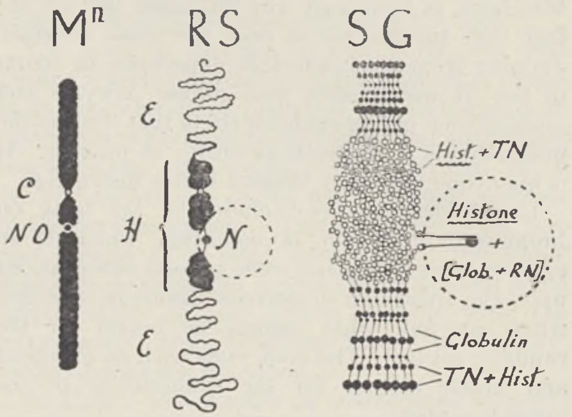

Fig. 1.

DIAGRAM OF A CHROMOSOME OF DROSOPHILA AT METAPHASE, NORMAL TEMPERATURE (M^n), RESTING STAGE (RS) AND AS A 'POLYTENE' STRUCTURE IN THE SALIVARY GLAND (SG), SHOWING THE DIFFERENT ORGANS REFERRED TO IN THE TEXT AND THEIR CHEMICAL CONTENT AS DETERMINED BY CASPERSSON. C, CENTROMERE; NO, NUCLEOLAR ORGANIZER; H, HETEROCHROMATIN; E, EUCHROMATIN.

Secondly, there is *heterochromatin*. Parts of certain chromosomes have long been known to show an abnormal retention or even extra charge of nucleic acid between metaphases. This property was first recognized in the sex chromosomes of animals, where it often goes with a modified timing of the reproductive cycle. Genetic evidence likewise reveals a differentiation. Certain parts of chromosomes, such as the *Y* in Drosophila, have long been held to be inert. They made little or no observable difference whether present in excess or absent altogether, and as might be expected, underwent no observable mutations. Recently it has been shown in plants and animals that the two properties of inertness and abnormality of nucleic acid cycle are combined in the same genes or chromomeres, whether making whole chromosomes or parts of them. These are then said to be heterochromatic as opposed to the active or euchromatic genes[9].

Thirdly, the nucleoli usually arise next to one or more particular chromomeres, the nucleolar organizers, which are again compound genes breakable by X-rays, and may be either at the ends or in the middle, either in a heterochromatic or a euchromatic part of the chromosome[10, 11] (Figs. 1 and 2).

All these different elements of nuclear structure, except the centromeres, are clearly visible in the giant nuclei of the salivary glands of Drosophila, and to these ultra-violet spectroscopy has been applied by Caspersson in combination with other methods. By these means he can distinguish quantitatively and qualitatively between the two nucleic acids or their nucleotides on one hand, with a very high maximum absorption at 2600 A., and the proteins with a vastly lower absorption and a maximum at 2750–2900 A. Of these he is able to distinguish between two types which he labels provisionally a histone type with a maximum above 2800 A. and a globulin type with a maximum which changes with the *p*H of the medium but is below 2800 A. in acid medium[4, 12].

The use of this technique has confirmed the picture so far outlined. But it has also gone much further. It has shown that the heterochromatin and nucleolus agree in having a high histone content. On the other hand, in the euchromatin the regions between the chromomeres contain globulin-type proteins. These higher proteins are lost in metaphase chromosomes or ripe sperm, in which only histones and thymonucleotides are recognizable. This leads Caspersson to argue that the active chromomeres or genes in the resting or gland nucleus are producing large globulin molecules while the inactive ones are producing small molecules of histone type which, although still individual, will be less specific in their interactions. The difference between activity and inertness would then be the difference between specificity and non-specificity; or better, perhaps we might say, between high specificity and low specificity. Further, Caspersson considers that the similarity of content between heterochromatin and nucleolus means that one secretes the material of the other, or we might suppose some precursor of it.

This view is confirmed by experiment. The addition of extra heterochromatin to the nucleus increases the size of the nucleolus in the pollen grain of Solanum[13]. A similar addition, in the shape of a *Y*-chromosome, to a Drosophila egg increases the concentration of ribose-nucleotides, or other pyrimidine-containing molecules, in the cytoplasm and likewise in the nucleolus[14].

Another connexion is revealed by the fact that the nucleoli are proportionately largest in cells which (with the exception of nerve-cells) are concerned with the most rapid protein production, for example, animal egg cells, meristematic and tumour cells. They are smallest in cells where no protein is being made, for example, in young animal embryos and in leucocytes. It is therefore significant that ribose nucleotide concentration increases as cells turn to protein formation. This is especially clear in yeast: nucleotides appear as soon as a source of nitrogen is added, having been entirely lacking even in the most actively fermenting yeast in the absence of such a source. Furthermore, the increase of ribose-nucleotides and of proteins goes with a specially high concentration of them next to the nuclear membrane where the proteins are shown by polarized light to be laid down in lamellar formation. They must be constructed on the very surface where nucleus and cytoplasm meet[15].

This is the argument. And Caspersson concludes that the nucleus is, as we should expect on even more general grounds, the centre of protein synthesis in the cell, that the nucleic acids are the essential agents of this synthesis, whether as polymerized thymo-nucleotides attached to the genes or unpolymerized ribose nucleic acid elsewhere. Further, Caspersson looks upon the changes in nucleic acid cycle of the heterochromatic genes as depending on differences in rate of protein production of the nucleus in different tissues, the genes being discharged of nucleic acid, their spiral threads uncoiled and their chromomeres separated in so far as the products of their own activities accumulate around them[4].

This account represents the first attempt to describe chromosome structure and activity in relation to cell processes as a whole. It is concerned with the types of molecules whose interactions govern these processes, but it does not tell us the sequence of their interactions. In order to discover this sequence, different methods are needed. Two kinds of experiment have so far proved successful. The first depends on the control of the general metabolism of the cell, or of the organism, by its inert chromosomes. The second depends on the control of the nucleic acid attachment of the inert chromosomes themselves by conditions which are developmental and genotypic as well as external.

The activity of the inert chromosomes or genes might plausibly be deduced from their widespread occurrence. But the precise study of their life-cycle in the individual organism and their distribution in the species makes it certain. Inert chromosomes frequently happen to have a defect of the centromere, which leads to their loss at mitosis. Even when this is not so, their irregular pairing leads to their loss at meiosis. Nevertheless, in species as remote as *Cimex lectularius*, the bed bug, and *Zea Mays*, indian corn, there seems to be a stable equilibrium of inert chromosomes in races or populations. The same is true of wild millet and cultivated rye (Sorghum and Secale). Such inert chromosomes must be preserved by positive selection. In some way they must be useful to the cells and the organisms containing them.

The case of Sorghum bridges the gap between plants and animals in another way. The inert chromosomes having weak centromeres are lost sooner or later in the development of all somatic cells. They are retained in the germ track. This distinction between soma and germ track recalls Ascaris, where parts of chromosomes, and Sciara, where whole chromosomes, are lost in all somatic cells. But in Sorghum we know that the chromosomes which undergo 'diminution' are in fact dispensable not only in parts of the plant but also in parts of the species. More than half the population have none. Diminution in the individual and equilibrium in the population are therefore two properties of inert chromosomes related by their common dependence upon being useful without being indispensable[16].

This condition of usefulness brings us back again to the notion that they are not indeed inert but rather non-specific in their activity; that their different products do not take part in a series of specific reactions co-ordinated in time and space with those of different active genes, but rather take part indiscriminately in all gene and cell reactions. This character might be due either to their production of smaller types of protein, as suggested by Caspersson, or merely to the control they have been shown to exercise over the production of nucleic acid.

Whatever the means, the end result, an effect of heterochromatin on cell division, is shown by the behaviour of pollen grains containing inert chromosomes in Sorghum. The first pollen grain mitosis, which produces the vegetative and generative nuclei, is normally followed after a week by the division of the generative nucleus to give two sperms. Instead, the vegetative nucleus in pollen grains with extra chromosomes at once divides again and goes on dividing until it has produced four or five generative nuclei, and in so doing has killed the cell. The thick wall confines this growth within the grain and makes it an encapsulated tumour.

These morbid mitoses suggest that the activity of the inert chromosomes in healthy tissues will serve to stimulate nuclear and hence cell division. Further, that healthy growth will depend on a correct euchromatin-heterochromatin balance, morbid growth on an incorrect balance, perhaps in cancer on a difference in balance between different cells of the same tissue.

The control of the nucleic acid attachment of the heterochromatin itself becomes from this point of view of more than trivial interest. Certain plants and animals with the largest mitotic chromosomes have well-defined blocks of heterochromatin amounting to a quarter or even half of the whole bulk. When the nucleus is brought into mitosis at a low temperature, below 6° C., equally in plants such as Trillium[17], Fritillaria or Adoxa[18], or in the newt Triton[19], the heterochromatin is starved of its nucleic acid. The segments in question appear scarcely stained by the Feulgen reaction. It seems as though the supply of nucleic acid has been reduced and the heterochromatin has been unable to compete equally with the euchromatin for the reduced supply (Fig. 2, below).

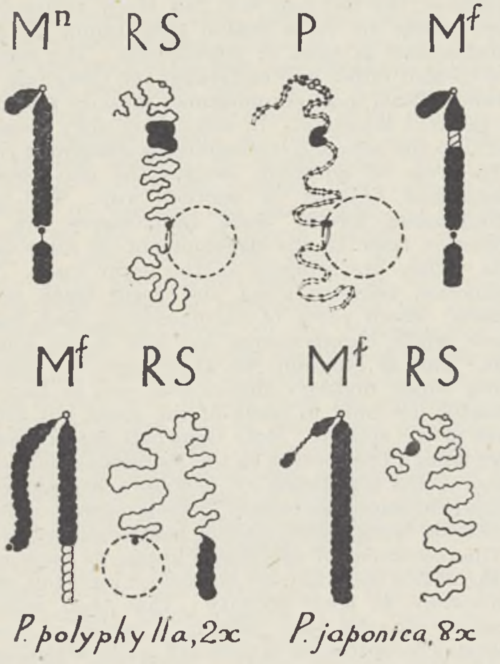

Fig. 2.

ABOVE: DIAGRAM SHOWING THE NUCLEOTIDE CYCLE OF A CHROMOSOME OF *Fritillaria pudica*. *P*, PAIRED AT PACHYTENE AND *Mf*, AT METAPHASE AFTER FREEZING. BELOW: INVERSION OF NUCLEOTIDE ATTACHMENT AS BETWEEN RESTING STAGE AND A CHILLED METAPHASE IN DIPLOID AND OCTOPLOID SPECIES OF PARIS. SPIRALIZATION OF HETEROCHROMATIN IS SUCCESSFUL IN *P. polyphylla*, UNSUCCESSFUL IN *P. japonica*.

This controlled starvation leads to derangement of two vital chromosome functions. First, the reproduction of the starved segments is hindered. Sister chromatids stick together, either at the ends or in the middle, and form bridges when they should separate at anaphase. This, when conditions other than temperature have happened to be abnormal, is a common source of chromosome breakage which in turn, by the way, must always lead to a change in heterochromatin balance[20]. Secondly, spiralization may be stopped and the heterochromatin appear as an entirely uncoiled thread at metaphase. This happens at meiosis in the male newt. Here the chromosomes have just emerged from a diffuse stage intercalated in the middle of the prophase and remarkable for having the heterochromatin uncharged, that is, for having no store of thymonucleotides. Similarly, it happens at mitosis in polyploid species of Paris and Trillium, which differ from diploids in having so small a stock of heterochromatin that again no thymonucleotides will be available within the nucleus (Fig. 2, below). Thus the nucleic acid attachment is necessary, not only as predicted for reproduction, but also for spiralization.

Conditions found in Nature advance the argument another step. In many animals of the heterozygous sex there is a large heterochromatic segment of the *X*-chromosome which is unpaired. In resting stages of the sperm mother cells and their antecedents this segment is strongly super-charged and there is no nucleolus. Apparently the transference of histones and exchange of nucleic acids surmised by Caspersson between heterochromatin and nucleolus has been blocked. During the prophase of meiosis this super-charging is strongest, and at the following metaphase a second remarkable property of the *X*-chromosome shows itself. Subject to variations in supply due both to genetic and to external conditions they are liable to fluctuate in their nucleic acid charge. They may be super-charged or sub-charged, or in the extreme case of the hamster Cricetus, they may be so little charged that they are unspiralized as in the experimental Triton[21]. Thus, like a lowering of the temperature, a suppression of the nucleolus can upset the regulation of the nucleic acid supply.

An adaptive effect of super-charging on reproduction is found in the Heteroptera. The normal pairing of the sex chromosomes is suppressed, and they divide at the first division instead of the second. Similarly, in many species of Drosophila there is a gene-complex 'sex-ratio' which exists in equilibrium in the population. Its effect is to increase the nucleic acid supply and therefore the charge on the heterochromatin at meiosis in the male. In consequence the division cycle of the *X* is advanced so far that it divides twice instead of once, and the *Y*-chromosome, immobilized by its heavy coat of nucleic acid, is lost in the cytoplasm. Hence the sperm all have *X* and the progeny are all female. This effect is reduced at higher temperatures so that up to six per cent of male offspring are produced. Evidently a causal sequence, temperature – nucleic acid charge – gene reproduction, is operative and can be used as part of the adaptive machinery of the species when it is combined with the usual high heterochromatic content of the sex chromosomes[22].

The imitation of natural abnormalities by experiment can take us further. Unfavourable conditions often produce a super-charging of the chromosomes. In maize a gene has this effect on the metaphase chromosomes, and an X-ray dose of 100 r. has the same effect. It is then found that the chromosomes are 'sticky'. What does this mean? When cold-treated chromosomes are X-rayed they show both stickiness and starvation. The charge on the heterochromatic segments remains less than that on the rest. They are thinner, but they are nevertheless coated with nucleic acid which stains deeply. It seems, then, that the stickiness is due to an excess of nucleic acid over the normal attachment and an excess with different physical properties[23].

The meaning of this effect becomes clearer when we realize that the X-rays act on the cell primarily by their effect on fibre formation. 50 r. will upset spindle development[23], but the germination of ripe pollen grains, a simple process not requiring fibre formation or even immediate nuclear control, is not disturbed by 80,000 r[24].

In this regard the distinction between fluid and fibrous elements, or at least surfaces, in the nucleus is important. The centromere, the nucleolus, the super-charged heterochromatin and the sticky chromosomes have a fluid surface. They run together. The normally charged chromosomes have a fibrous surface based on their fibrous framework. They stand apart. This difference between fluid and fibre would seem to depend on the polymerization of thymonucleic acid in contact with the chromosome. Here, again, there is a minor interlocking system of control, for while we saw that the nucleic acid charge controls the division of the centromere as well as of the whole thread of the sex chromosomes, the centromere itself often appears to act as the organizing centre for the charging of the chromosomes. At meiosis it then controls their pairing, which runs on a zip principle from the centromere to the two ends. In a word, the centromeres organize fibre formation both in the nucleus and on the mitotic spindle.

Thus we see a chain of reactions : the chromosome thread controls the polymerization of its thymonucleotide charge. This in turn controls the spiralization and, as would be expected, the reproduction of the thread with its genes. Hence the whole course of events can be controlled by temperature and other cell conditions as well as by the balance of heterochromatin and the organization of the nucleolus.

In this way the pattern of nuclear structure and organization is beginning to appear. But in answering some old questions we have, of course, raised far more new ones. Is the protein fibre of the chromosomes a single or a multiple chain ? Is a difference in multiplication or in charge responsible for differences in chromosome size ? Why have the prosthetic groups, which represent the genes and express themselves so clearly as chromomeres, active or inert, remained unidentified ? How does the nucleic acid attach itself to these groups and so control mating and reproduction (both limited to pairs) ? Is nucleic acid the agent of reproduction, or only of separation, of the main chain or of the prosthetic groups or of both ? If it controls spiralization, is it itself polymerized in a spiral with a limited number of stable positions ? How can the nucleic acid charge at prophase of meoisis be limited in quantity or arrangement so as to avoid reproduction and spiralization long enough to permit pairing ?

These and many other questions we can now attempt to deal with in a co-ordinated way. This we can do because at the same time that a new means of knowing the chemical structure and activity of the chromosomes and genes has been placed in our hands we also find ourselves provided with a variety of means of controlling this activity and modifying this structure ; with the instruments, in fact, for showing cell physiology and chromosome mechanics, no longer as opposite sides, but as interlocking parts of one system.

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EDMOND HALLEY, 1656-1742

By DR. H. SPENCER JONES, F.R.S.

Astronomer Royal

ON January 14, 1742, died Edmond Halley, a remarkable man whose name is familiar to the public through the famous comet that is called after him. Born on October 29, 1656, in affluent circumstances, Halley took an early interest in astronomy. He went to St. Helena for two years, 1676–78, to observe the positions of bright southern stars, and while there observed the transit of Mercury of November 7, 1677, being the first person to observe both ingress and egress at the same transit. On his return, he published in 1679 the "Catalogus Stellarum Australium" ; in this he referred to the utility of observations of transits of the inferior planets for determining the solar parallax. Reverting to this subject in the *Philosophical Transactions* of 1694 and 1716, he proposed that the length of time taken by the planet to cross the sun's disk should be observed at a number of suitably selected stations ; from the differences in these times, the solar parallax can be inferred. The method has the advantage of not requiring elaborate instrumental equipment but suffers from the disadvantage that it requires the visibility of both entrance and exit at the same station. The method was widely used at the transits of Venus of 1761, 1769, 1874 and 1882.

Shortly after his return to England in 1678, Halley was elected a fellow of the then young Royal Society, of which in 1685 he became clerk and in 1713 one of the secretaries. In 1682 he made observations of the position of the bright comet that bears his name. It was probably this comet that turned Halley's attention to the consideration of the law of force under which an elliptic or parabolic orbit is described. He discovered in 1684 that for circular orbits with the sun in the centre the force for different orbits varies according to the inverse square of the distance. Being unable to solve the problem of the law of variation of the force for an elliptic orbit, he visited Newton in Cambridge in August 1684 to discuss the matter with him. He found to his surprise that Newton had already solved the problem and was able to supply the answer, but had mislaid his demonstration. Newton therefore worked out the proposition afresh and sent it in November to Halley, who made a further visit to Newton to encourage him to continue his researches. It was due to Halley's encouragement that the manuscript treatise, entitled "Philosophiæ Naturalis Principia Mathematica", which forms the first book of the "Principia", was presented to the Society in April 1686. The Society ordered that the book should be printed, but the state of the Society's finances at the time was such that it could not bear the expense. At the meeting of Council on June 2, 1686, it was accordingly resolved that the book be printed and "that E. Halley shall undertake the business of looking after it, and printing it at his own charge, which he engaged to do". Thus, as de Morgan remarked, Halley's "share in the production of the *Principia* entitles us to say that but for him, in all human probability, that work would not have been thought of, nor when thought of written, nor when written printed".

After Newton had demonstrated that the orbits of comets were sensibly parabolic and had devised a method for determining the elements of a comet's orbit, Halley collected all recorded observations of comets that had any claim to accuracy and computed the orbits of twenty-four comets. Among these were three that showed remarkable similarity: the comet of 1531, observed by Appian; that of 1607, observed by Kepler; and the comet of 1682, observed by Halley himself. Historical records of the appearances of comets in 1305, 1380 and 1456 confirmed his suspicions that these were all returns of the same comet. No method was then available for computing the perturbations due to the planets but, making an approximate estimate of the perturbing action of Jupiter, Halley concluded that the comet would be seen again about the end of 1758 or the beginning of 1759. "Wherefore", he remarked, "if it should return according to our prediction about the year 1758, candid posterity will not refuse to acknowledge that this was first discovered by an Englishman." Intense interest was taken in this prediction as the time for the return of the comet approached; it was a test question put by science to Nature. The discovery of the comet on Christmas Day, 1758, and its perihelion passage on March 12, 1759, was one of the most outstanding triumphs that Newton's theory had achieved.

In 1625 Kepler had found that the observed places of Jupiter and Saturn could not be reconciled with their accepted mean motions. The inequality in the motions of these planets was explained by Halley as the effect of their mutual attractions. A more puzzling phenomenon was discovered by Halley in 1695. By examining the records of ancient eclipses, he was led to the conclusion that there was an acceleration of the mean motion of the moon. This was amply confirmed after Halley's death, and many of the greatest mathematicians and astronomers endeavoured to find the explanation. In 1787 Laplace announced that the acceleration was the result of a gradual decrease in the eccentricity of the earth's orbit, produced by the action of the planets on the earth. In 1853, however, J. C. Adams found that the calculations of Laplace were incomplete and that the correct theoretical value of the secular acceleration of the moon's motion was only about half the observed value. The cause of the residual acceleration was not found until 1920, when the work of G. I. Taylor and H. Jeffreys proved that it was the result of a gradual slowing down of the rotation of the earth, produced by tidal dissipation of energy in shallow seas.

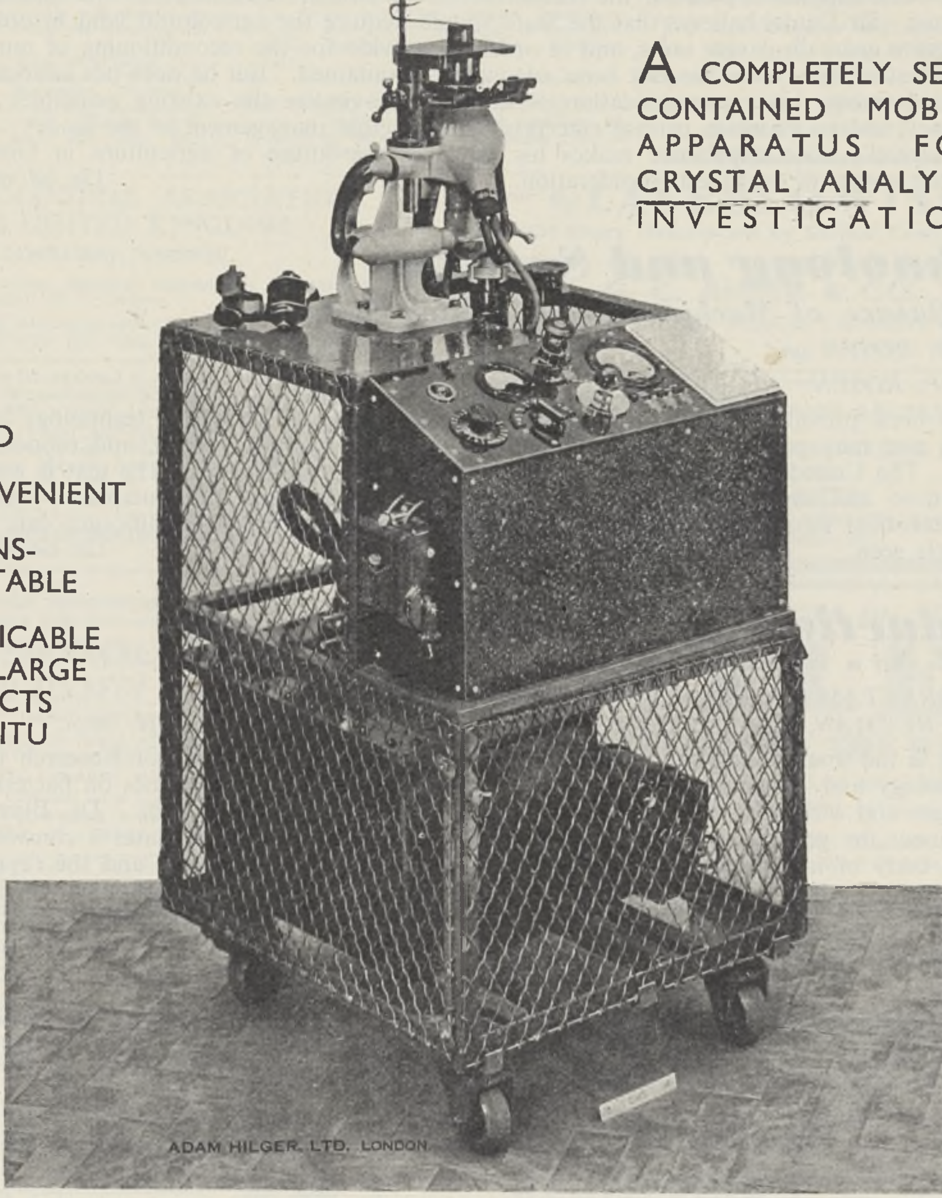
Another important discovery made by Halley was that of the proper-motions of the stars. In the *Philosophical Transactions* of 1718 he announced that Sirius, Aldebaran, Betelgeuse and Arcturus had changed their positions in the sky since the time of Ptolemy; the old idea that the stars were absolutely immovable with respect to each other was thereby disproved.

But Halley was not merely a great astronomer. He made important contributions to many other branches of natural philosophy. In 1688 he produced the first meteorological chart, showing the trade-winds over the oceans, based partly on his own observations. He was interested in the theory of the earth's magnetic field. King William III, being desirous that the variations of the compass should be observed in various parts of the Atlantic Ocean, for the benefit of navigation, gave Halley a commission as a post captain in the Royal Navy in command of the pink *Paramour*. The voyage lasted for two years, 1698–1700, reaching as far south as lat. 52° 30′ S. Numerous observations of the declination were made, from which a sea-chart for the Atlantic Ocean, showing the isogonals or lines of equal declination, was constructed. This chart was published in 1701 and was a valuable aid to navigation. The novel method that Halley devised for exhibiting the data is still used for magnetic charts. In 1702 he published a more extended chart, covering the whole world, which he based on all available observations. In 1701 he also carried out for the Admiralty an exact survey of the tides in the English Channel.

Halley's versatility is further indicated by his construction of the first mortality tables, thus beginning the science of life statistics.

In 1703 Halley was appointed Savilian professor of geometry at Oxford. His labours in his new position were in the neglected field of the remoter Greek geometry. He translated and edited an Arabic version of the lost work of Apollonius "De Sectione Rationis". In collaboration with David Gregory, he undertook an edition of Apollonius. But, in consequence of the sudden death of Gregory in 1708, when less than a quarter of the work had been accomplished, it was left to Halley to carry it through to completion. This edition, the first and, until the latter part of the last century, the only printed Greek text of Apollonius, was a tribute to Halley's industry and scholarship.

On the death of Flamsteed, the first Astronomer Royal, in 1719, Halley was selected in 1720 as his successor at the Royal Observatory, Greenwich, being then in the sixty-fourth year of his age. Flamsteed's instruments, the cost of which had been defrayed out of his own pocket, had been removed by his widow, who claimed them as her own property and succeeded in maintaining her claim against the objections of the Admiralty. The Royal Observatory had thus practically to begin again. Halley obtained a grant for new instruments and equipped the Observatory with a transit instrument and a mural quadrant by Graham. The chief work he did as Astronomer Royal was to make observations of the moon through an entire saros period of eighteen years, with the view of improving tables that he had published in 1719; these were intended to enable longitudes at sea to be determined by the method of lunar distances. It does not appear, however, that the revision of the tables was ever attempted. Though Halley had a more versatile and original mind than Flamsteed, as Astronomer Royal he achieved less, for he did not so fully appreciate those habits of minute attention that are necessary for the attainment of a high degree of accuracy in routine programmes of astronomical observation. The work for



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which his name will remain famous was completed before his appointment to Greenwich.

Astronomer, geometer, mathematician, physicist, geographer, practical seaman and navigator, scholar and critic—Halley filled all these roles with distinction. As de Morgan said, "Wherever Halley laid his hand, to do work cut out by himself, he left the mark of the most vigorous intellect, the soundest judgment, the most indomitable courage against difficulties." The name of Edmond Halley will always hold an honoured place in the history of English science.

CONFERENCE ON SCIENCE AND THE WAR EFFORT

IT is natural to compare the Conference organized by the Association of Scientific Workers on January 10 and 11 with that convened last October by the Division for the Social and International Relations of Science of the British Association. The difference was striking. Whereas the October Conference was concerned with post-war planning, this conference discussed in a practical way the immediate scientific and technical problems of the War itself. Even more noticeable was the difference in the type of person who, in general, attended and spoke. Here were gathered together in the main rank-and-file men of science fresh from their work in laboratories, factories and research institutions all over the country. They came not only with grievances and criticism (of which there were plenty), but with proposals for better co-ordination of research and better utilization of our technical personnel. However, the Conference was not dominated by youth. An encouraging feature was the support it received from distinguished men of science, although the amount of this support would not appear to have been commensurate with the importance of the topics discussed. These topics ranged from the training of technical personnel and the university education of scientific workers to the organization of maximum productive effort. In addition, there were important contributions on the subjects of food and agriculture, and building, housing and A.R.P.

Sir Daniel Hall, vice-president of the Association, who opened the Conference, emphasized that men of science must have regard to the actual machinery by which Government is carried on, otherwise their proposals would receive scant consideration. He stated for the consideration of the Conference that the real problem was for scientific workers and the Government itself to find the machinery which would ensure a proper method of using the expert. Captain L. F. Plugge, chairman of the Parliamentary and Scientific Committee, welcomed the Conference on behalf of his committee, and expressed the hope that his Committee would be informed of the matters discussed, so that they could be followed up. New methods in building worked out as a result of the war-time shortage of materials were described by Dr. R. Fitzmaurice, of the Building Research Station. Prof. J. B. S. Haldane pointed out that had many of the recommendations of the A.R.P. Co-ordinating Committee been adopted, not only would there have been an immense saving of life but also a saving of materials and money.

Sir John Orr treated nutrition from the point of view of its effect upon the efficiency of the worker, soldier and civilian. He pointed out that considerable increases in food production are necessary to provide a decent standard of health. Dr. H. M. Sinclair, of the Department of Biochemistry, Oxford, emphasized that the primary cause of malnutrition is poverty, with the secondary factors of ignorance and the decreased availability of familiar foodstuffs. Sir Daniel Hall outlined a post-war policy for agriculture. He characterized the policy of high prices as a policy of scarcity, and called for national ownership of our limited land area. Sir John Russell, Prof. H. D. Kay, Prof. F. G. Gregory, and Dr. A. Walton contributed to an extensive discussion. Prof. J. A. Carroll called for a co-ordination between school and university, and for an inquiry by such a body as the Association of Scientific Workers into the scope and content of courses. Mr. J. A. Lauwerys discussed elementary technical education, and suggested that a closer contact between schools and the industrial world would be valuable. Both sessions on education were marked by the practical detail of the discussions.

The two sessions on January 11 were devoted to the place of the industrial and Governmental scientific worker in the war effort. Prof. W. Wardlaw, and Mr. F. M. H. Markham, of the Central Register, spoke and answered criticisms of the working of the Register. Mr. E. D. Swann, of the executive committee of the Association of Scientific Workers, outlined the Association's case for a select committee to investigate the whole question of the utilization of scientific personnel and for the production executive to appoint a technical personnel committee. Prof. H. Levy asked for a place for scientific men in the commands of the fighting forces, while Mr. F. Morgan, an operational research scientist attached to an R.A.F. Command, outlined the vital work which he and his colleagues are doing, and made suggestions for its improvement. Mr. Halse, of the Industrial Committee of the Association, gave numerous examples of inefficiency in the actual working of industry. Mrs. P. Clarke spoke of the low rates of pay of explosives chemists, which compare unfavourably with those received by unskilled personnel. Drs. Garland, Stanford and McClean made out an impressive case for better medical services in industry, and the consequent effect on production.

Scientific workers from a variety of undertakings took part in the discussions. The unanimous opinion seemed to be that production is being handicapped by lack of scientific training, mismanagement and inefficiency in high places, and through the spirit of peace-time competition between firms. Lack of contact between the Services and scientific workers was emphasized. Mr. J. A. Henley summed up this part of the conference while Prof. J. D. Bernal dealt with the proceedings as a whole. He stated that if the whole truth could be told, the situation would seem to be even worse than that described by the speakers from their first-hand experience. He said that attempts by men of science to better the situation would meet with opposition from industry and from the Government. In his view, the opposition to scientific workers in the last few months is equivalent to sabotage and perhaps something rather stronger. He underlined the need for speed in view of the urgency of the situation.

Thus ended one of the most significant gatherings of British scientific workers held during the War. It ended on a note of action, as representations by the Association are to be made to the Ministries of Labour and of Supply as a direct result of it. It is to be hoped that the facts which came to light will be most seriously considered by these Ministries.

OBITUARIES

Dr. H. Eltringham, F.R.S.

HARRY ELTRINGHAM, who died on November 26, was the eldest son of J. T. Eltringham of South Shields, and was born in 1873. Educated at South Shields High School, and then at Durham School, he was destined for a business career with science as a background. His natural leanings to science owed much in his youth to his father's encouragement. He entered Trinity College, Cambridge, in 1891, and took an honours degree in natural science, after which he spent a year in the engineering 'shops' studying mechanical drawing and practical work. His father's shipbuilding business claimed him for some years after, but in 1908 he retired, and devoted himself to the study of insect mimicry, which had already attracted his attention.

Eltringham went to Oxford to study under Prof. E. B. Poulton, and in 1910 his fine book, "African Mimetic Butterflies", profusely illustrated with plates from his own coloured drawings, was published by the Clarendon Press. The intricacies of mimicry among Acraeine butterflies attracted him, and in 1912 he wrote a monograph on the African species of Acraea, thoroughly revising this difficult genus and describing new forms and species. Later, he treated similarly the neotropical genus Heliconius in a superbly illustrated paper (1916), discussing the specific and mimetic relationships.

Taxonomic studies necessitate anatomical research, and Eltringham was led to the histological studies for which he will be chiefly remembered. Field naturalists in Africa had described the habits in courtship of Amauris butterflies, which seemed to depend upon the charging of an abdominal brush with secretion from special areas on the wings, and dissemination of this presumed scent to the female by protrusion of the brush. Eltringham in 1913 described fully the histology of the parts in two species, following this account with a further paper in 1915. Similar structures in the allied Oriental genus Euploea were described in 1935 in a communication to the Royal Society, to which he had been elected in 1930.

These studies led Eltringham to consider other specialized structures, and numerous papers on glandular, tympanic, and brush-organs, and special sense-organs of unknown function in Lepidoptera and other insects came frequently from his pen at Oxford and, after 1935, from Stroud, where he equipped his own laboratory. One of the best known, entitled "Butterfly Vision", described with very finely executed drawings the minute anatomy of the compound eye. A microphotograph of Prof. Poulton, taken through the eye of a glow-worm, added interest to the discussion of theories of insect vision. One of the latest studies, in 1936, dealt with the eyes of tsetse flies. Eltringham's greatest histological successes were the description in 1920 of the apparatus, apparently for producing scent, concealed in a protrusible pouch in the back of the head of Hydroptila, a caddis-fly only a few millimetres long, and the account in 1933 of the anatomy of tarsal sense organs in Lepidoptera; also the account, published in 1928 by the Royal Society, of the silk-producing glands in the front tarsi of the small Empid fly Hilara, the amazing courtship of which had been watched by A. H. Hamm.

Eltringham's aptitude for drawing was enhanced by his engineering training: he despised no mechanical aid to producing accurate representations, and his illustrations demonstrate clearly what he describes. Similarly, his ingenuity enabled him to devise and make a vertical projection apparatus for drawing microscopical preparations, and a camera for very low-power microphotography. Other apparatus, such as a rocking stage for the microscopical examination of insects, keeping them always in focus, and an improved air pump for laboratory use, are on the market. His book on "Histological and Illustrative Methods for Entomologists" (Oxford, 1930) was the outcome of his own experience.

Eltringham also wrote in 1923 an engaging little book, "Butterfly Lore", dealing with the economy of a butterfly from egg to adult, and, in 1933, "The Senses of Insects". His last published work was "The Mind of the Bees" (1936), translated from the French of Julien Françon. The majority of his papers, numbering about seventy, were published by the Royal Entomological Society of London, of which he was president in 1931–32.

Eltringham was no mean athlete: he secured his Trial Eights cap at Cambridge and was well known as a skater in Switzerland, where he was twice among the judges at the English championships: he held the Gold Badge of the 'Bear' skating club. He was a friendly man but surprisingly self-contained: he had a keen appreciation of beauty in music and a colourful garden. He left Oxford to help his sister tend their mother at Stroud in her failing health, and after her death lived there. He was unmarried.

G. D. HALE CARPENTER.

Mrs. Hertz

THE death occurred on December 29 of Mrs. Hertz, widow of Dr. Heinrich Hertz, whose name will always be associated with the beginnings of radio communication.

Mrs. Hertz came to England in 1936, at the age of seventy as, although 'Aryan' herself, her husband's Jewish ancestry made it undesirable for her to continue to live in Germany. Admirers of her husband's work and the Marconi Company made it possible for her to live in England, and her two daughters also. The elder daughter had had a large medical practice among children at Bonn, where she lived with her mother; the younger did distinguished work in psychological zoology in Berlin, which she has continued at Cambridge.

Mrs. Hertz was a native of Karlsruhe, in Baden. A few years ago the late Pope made her a donation of £200 in acknowledgment of a gift of one of her husband's manuscripts to the Vatican Library. Another manuscript Mrs. Hertz generously gave to the library of Trinity College, in commemoration of Sir J. J. Thomson's eightieth birthday.

JOAN THOMSON.

WE regret to announce the following deaths:

Mr. J. P. d'Albuquerque, formerly director of science and agriculture, Barbados, on December 20, aged seventy-five.

Major Edwin C. Eckel, chief geologist, since 1933, of the Tennessee Valley Authority, on November 22, aged sixty-seven.

Prof. D. D. Jackson, formerly professor of chemical engineering in Columbia University, aged seventy-one.

Prof. R. D. Rudolf, emeritus professor of therapeutics in the University of Toronto, on November 2.

NEWS and VIEWS

Scientific Societies and Post-War Problems

After winning the War of 1914, the Allies lost the peace because of the inability of statesmen and public opinion to understand the dependence of national security on world order and the dependence of world order upon truly workable international relations. After the defeat of Nazism, the mistakes of the last twenty-two years must be avoided by the victorious nations. Hitler has a 'new order' for Europe which is apparently an old-fashioned Roman peace. Aside from the very general Atlantic Charter signed by President Roosevelt and Mr. Churchill, no definite peace plans have been advanced by the Allies, although many groups both in and out of Government circles are working on aspects of the problem. The American Academy of Arts and Sciences is devoting its regular monthly meetings, November until May, to the subject of "Analysis of Post-War Problems and Procedures". The Academy, which has approximately eight hundred members elected from a wide variety of professional fields, includes men who are competent to give considered views on the natural and social sciences and in engineering and affairs; and the meetings are being held on the second Wednesday of the month at its Boston house under the chairmanship of Dr. Harlow Shapley, president of the Academy. On the Monday following, there is a forum directed by leaders chosen to discuss matters raised by the preceding Wednesday evening's speaker.

Prof. A. N. Whitehead, emeritus professor of philosophy at Harvard University, opened the series in November with a paper entitled, "Statesmanship and Specialized Learning"; Samuel Cross, J. Seelye Bixler and Hans Kelsen, also of Harvard, led the forum following this communication. The meeting on December 10 was concerned with problems of communication and transportation in a post-war world. Igor I. Sikorsky, engineering manager of United Aircraft Manufacturing Corporation, spoke "On the Air Transportation of the Future". Walter S. Lemmon, president of the World Wide Broadcasting Foundation, spoke on "Radio as a New Force in the Post-War World". The forum on December 15 was led by Douglas H. Schneider, programme manager of Station WRUL, and Joseph S. Newell, professor of aeronautical structural engineering at the Massachusetts Institute of Technology. The January 14 meeting is being addressed by Zechariah Chafee, jun., Langdell professor of law at Harvard University, on the subject of "International Utopias". Among the topics for later meetings will be considerations of sources and availability of raw materials in a post-war world and discussions as to how the social sciences may best be utilized to implement the ideals of democracy.

Aircraft Defence against Barrage Balloon Cables

Photographs of German Heinkel III aircraft, shot down recently, reveal the fact that these machines are fitted with a balloon cable fender not very different from designs tried by both sides during the latter part of the War of 1914–18. It consists of a metal rail, V-shaped in plan form, attached to the wing tips with the point of the V carried on a pylon forward of the nose of the machine. Thus, when meeting a cable it is fended off by being slipped round the wing tip. The weight and drag of the device is considerable, and has an appreciable effect upon the performance. British machines now use a row of small cable cutters along the leading edge of the wings. If the cable strikes between the cutters it slips along until it reaches the nearest one. This device is considered to be better, in that it releases the balloon, and clears the way for any following machines. The weight is less than that of the German fenders, although the comparative aerodynamic effects are not certain. The problem of ice formation on either type is likely to be serious, and in this case the British design, placing the cutters in the wing, which is probably already fitted with de-icing devices, is less likely to accumulate serious ice formations than the German exterior structure.

Czech Medical Work in Britain

Shortly after the Czechoslovak Government was formed in London, a Department of Public Health was set up under its Ministry of Social Welfare to meet the needs of Czechs in Britain and to prepare for the onerous duties that await them on the liberation of their country. There are about 250 qualified Czech medical men and women in Great Britain. Many are serving with Czechoslovak army units, others are with the merchant navy and some (in co-operation with the Red Cross) are concerned with the welfare of their countrymen resident in Britain. There are clinics and wards in certain hospitals at their disposal and a Czechoslovak Medical Association in Great Britain has been formed to hold regular scientific meetings. Through the Czechoslovak Research Institute, it has just issued the first number of a *Bulletin* in English, to which Lord Horder has contributed the foreword. Lord Horder points out that medicine knows no racial distinctions and recognizes no geographical boundaries. Both nations (Czech and British) are allies and friends opposing the medievalism into which Nazi Germany would thrust all man's endeavours. The paralysis of the advance of medicine which war induces is one of the most serious effects of the crime committed by Germany against civilization, yet Czech medical men are keeping alight the flame of learning and of healing so that, when victory comes, medicine will shine again in the new home they will provide for her.

The *Bulletin* contains several informative articles on current Czech medical work. Before it was overrun by the Nazis, the country had an efficient and well-organized medical service with one practitioner to every 1,500 inhabitants. There were 548 hospitals with 90,000 beds, while all classes of the community could take advantage of the country's unique spa and sanatoria facilities. After the War ends, Czechoslovakia will be in urgent need of medical men, and it is important that Czech medical students now in Britain should complete their studies in readiness for future duties in the homeland, where there is no rising generation of doctors since the Nazis have closed all the medical and scientific faculties of the Universities of Prague and Brno.

New Mexican Observatory

A new national observatory which will house a 24–30 in. Schmidt photographic telescope, claimed to be the most powerful in the tropics, is being built in Mexico. Other equipment will include a 12-in. reflector for visual observations and two or three cameras of the Ross type with apertures of 3–5 inches.

The observatory will be situated on a hill ten miles south of the city of Puebla, which is eighty miles east of Mexico City. This is a very favourable location in the southern hemisphere for observation. The latitude of the observatory is 19° N., which means that the sky can be seen to within 19° of the south celestial pole. The site is nearly eight thousand feet above sea-level. The work of the observatory will be closely linked with that of the Harvard College Observatory and of the Mexican Observatory at Tacubaya. It will consist largely of observations of southern variables and of star counts, colours, magnitudes and spectra for the southern hemisphere. The director of the observatory will be Mr. L. E. Erro, assisted by Dr. Carlos Graef, both of whom have already spent a year working at Harvard College Observatory.

Post-War Zoos

THE forty-first Bulletin of the North of England Zoological Society deals with the increasing difficulties facing societies which will have to maintain zoological collections during 1942, and makes a plea for public recognition of the zoological garden on the same standing as the art gallery and museum. The Society's zoo at Chester, like other collections at Dudley and Maidstone, saw a considerable increase in attendance in 1941 compared with the disastrous figures in 1940—Maidstone had about 40 per cent of normal pre-war years—and it is planned to invest money for post-war construction plans. "Not only in this country, but one might say all over the world, the problems of preserving the zoological collections will become more and more difficult as the war progresses from stage to stage" it is noted, adding, "It is very unfortunate that in the past both museums and zoos have suffered from a certain amount of apathy from both the government and the local authorities with the inevitable result that their development has been retarded. Many zoological societies have had to introduce various methods to raise money which most of them would like to have left entirely alone, but the necessity of raising funds left them no alternative. In the post-war period it is likely that art galleries and museums will receive more financial support from government and local authorities, but I am afraid that for some time to come zoological gardens will have to depend upon their pre-war sources of income." Among the post-war zoo ideas are a greater use of open spaces to display the animals to a better advantage, using ditches instead of iron bars and railings, to improve the labelling of exhibits instead of relying upon commercialized guide-books to impart the necessary information to the novice visitor, and more use of zoos by schools with the establishment of zoo lecture halls. The difficulties facing such schemes and how they might be overcome are dealt with.

The Birds of Leicestershire

THE Leicester Literary and Philosophical Society has formed an Ornithological Society for Leicestershire and Rutland, which is compiling a report on past and present field records, to be issued in 1942 as a preliminary to bringing up to date Montagu Browne's 1889 "Fauna of Leicestershire". A meeting in Leicester Museum last September decided to form an Ornithological Society, as a sub-section of the Leicester Literary and Philosophical Society, to meet monthly, Mr. F. Brady being elected chairman and Mr. A. E. Jolley secretary. A duplicated December bulletin, just issued, records the little owl, kestrel, partridge, red-legged partridge and a flight of grey geese within Leicester City bounds, and at the sewage farm a flock of tree sparrows, while a pectoral sandpiper is reported from Northampton Sewage Farm. At a large starling roost at March Covert, near Lockington, the ground was found to be littered with rubber bands believed to have been swallowed by the birds and later either vomited or passed in their excreta. They varied from fruit bottle to tobacco tin bands. Similar instances of this type have been recorded elsewhere with arctic terns, gulls and rooks, and it is probable that the birds mistake them for food, afterwards ejecting them as undigestible. At the flooded Wanlip osier beds, teal, pochard, shoveler and wigeon have been observed among the duck, as well as snipe, curlew and a peregrine. A sheldrake is recorded inland from the River Sence near Kilby Bridge. Although only opened in 1941 the Eye Valley Reservoir has already proved an important bird haunt.

Health of Scotland

ACCORDING to the report recently issued by the Department of Health for Scotland for the eighteen months January 1939 to June 1941, the health of that country in 1939 reached a level never attained before. The severe winter of 1940–41, however, was responsible for the deterioration in the first quarter of 1941 when the infantile mortality rose to 109. In 1939, 7,176 cases of tuberculosis with 3,526 deaths were reported, and in 1940, 7,670 and 4,003 respectively, while in the first half of 1941 the figures were 4,300 and 2,300. With the exception of tuberculosis, the War has so far not had much influence upon infectious diseases, unless the increased incidence of cerebrospinal fever be attributed to war conditions. There was an increase in diphtheria of about 50 per cent in 1940 over 1939, but in 1941 the incidence declined; about 440,000 children of school age and under, or approximately 40 per cent of the child population, have been immunized.

Rotation of the Milky Way

A SUMMARY of the most up-to-date knowledge of the galaxy is provided by an article by Frank K. Edmondson in the *Telescope* of September–October. A short historical outline of the subject is given, commencing with Glydén's discovery in 1871 of the galactic rotation effect in stellar proper motions, and dealing finally with recent research on the constancy of orbital velocity over a range of about 5,000–15,000 parsecs from the galactic centre. The explanation of this constancy in the rotational velocity is that the distribution of stars in the galaxy lies between high concentration towards the centre and uniform distribution. It has been estimated that the number of stars per unit volume near the centre must be a hundred times that in the neighbourhood of the sun. If this is correct, the sky should appear very brilliant in the direction of the galactic centre. As it does not do so, it is believed that huge clouds of dark interstellar matter partially conceal the centre from our view. For this reason the mysteries of that massive nucleus which lies behind the interstellar veil can be penetrated only through the assistance rendered by the study of star motions.

Electric Discharge Lamps

THE War has forcibly directed attention to artificial lighting both indoors and out of doors. Black-out conditions in towns with their mentally depressing effects, their restrictions on social intercourse and their responsibility for more street accidents have emphasized man's dependence upon electric lighting. Indoors, particularly in modern factories which, like Hardwick Hall, are more glass than wall, the same black-out conditions have resulted in the continual use of artificial light even in the day-time. Specially welcome, therefore, is the interesting account of "Electric Discharge Lamps", written by V. J. Francis and H. G. Jenkins, recently published from the Research Laboratories of the General Electric Company in England. In about sixty pages an excellent technical account is given of "Osira" and "Osram" fluorescent tubes and their operating equipment. The many illustrations include spectrograms and oscillograms obtained from the tubes in operation. The story of the development of the tubes is an excellent illustration of the application of advanced academic physics in industry, and peace-time may well see the discharge lamp, historically the earlier, replacing the heated filament bulb.

Malayan Wild-life

REFERRING to the notes on Malayan wild-life in NATURE of January 3, p. 17, Mr. F. F. Laidlaw writes: "the orang outan does not occur in the Peninsula, though it is of course found in Sumatra. The Malayan wild cattle is scarcely a bison, its native name should read sĕladang, and the Malay name for the flying fox is kluang. The common rhinoceros, now I believe preserved. was hunted for its horn, not for ivory, and the tusks of the Malayan elephant are usually too small to be of much value. It was hunted partly as a nuisance, and partly because it was an elephant! There is a likelihood of some confusion in the use of the term Malayan, meaning 'of the Malay Peninsula', opposed to Malaysian, which refers to the Peninsula *plus* the great islands, Sumatra, Java, and Borneo. For this latter concept 'Sondaic' might be better. 'Sundaland' is, I believe, used to denote all the lands of the Sunda shelf".

Synthetic Rubber in the United States

IT is announced that the leading rubber, oil and chemical companies of the United States have agreed to pool their patents and technical processes to construct plants with a capacity of 400,000 tons of synthetic rubber a year. The undertaking is expected to cost about £100,000,000.

Announcements

THE Bessemer Gold Medal of the Iron and Steel Institute for 1942 has been awarded to Mr. Eugene G. Grace, president of the Bethlehem Steel Company, in recognition of his valuable services to the iron and steel industries and in appreciation of all he has done to foster technical, scientific and industrial collaboration between the industries in Great Britain and the United States.

THE Committee of the Athenæum has elected the following gentlemen under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature or the arts, or for their public services: The Right Hon. Sir John Anderson, Lord President of the Council; Admiral of the Fleet Sir Dudley Pound, First Sea Lord of the Admiralty; General Sir Archibald Wavell, Supreme Commander, South-West Pacific Area.

FATHER W. MCENTEGART, Heythrop College, Chipping Norton, Oxford, has written referring to Prof. W. G. de Burgh's review of Dr. Osborne Greenwood's "Christianity and the Mechanists" in NATURE of November 29, p. 637, where the following passage occurs: "Even Aquinas held that reason could not disprove the eternity of the material world and that the belief in Creation could be authorized only by revelation". Father McEntegart points out, and Prof. de Burgh concurs, that the words "in time" should have been inserted after the word "Creation".

DR. G. F. HERBERT SMITH, British Museum (Natural History), London, S.W.7, writing in connexion with the article "Nature Preservation and National Life" in NATURE of Jan. 3, p. 1, states that the Conference of the Society for the Promotion of Nature Reserves, a memorandum of which is referred to, remains in being, and correspondence for it should be addressed to him.

SIR ARTHUR HILL, former director of the Royal Botanic Gardens, Kew, who died on November 3, left £93,379 (net personalty £92,653). He bequeathed £1,500 to the chapel fund of King's College, Cambridge, to provide carved statues in wood, a small statue of Henry VI, a silver tankard dated 1686, and his Dutch tiles to King's College; £200 to the supplementary expenses fund of King's College, and to a fellow of the College his doctor of science gown and hood; certain silver and other articles to the Archæological Museum of the University of Cambridge; £1,000 to the Bentham-Moxon Trustees of the Royal Botanic Gardens, his diaries of various journeys to the library of the Royal Botanic Gardens, and £500 to Kew Guild; his great Bible of Henry VIII to the Vaughan Library, Harrow School; £1,000 to the Royal Society; other bequests chiefly to religious bodies, and, after personal bequests, the residue as to one-eighth to King's College, Cambridge, and one-eighth to Marlborough College.

THE Medical Research Council invites applications from medically qualified women for a studentship for training in methods of experimental psychology; preference will be given to candidates who have had some special training in physiology or neurology, or who have already had some experience in the use of research methods. The studentship will be tenable for six months during which the holder will receive training under the direction of Prof. F. C. Bartlett at Cambridge. Payment will be at the rate of £350 per annum, and the student will be expected to give her whole time to the work. The award will be made with the view of possible opportunities for research into problems arising during the War, either in the services or in industry, but no definite promise of employment after the expiry of the studentship can be given. Applications should be sent to the Secretary, Medical Research Council, c/o London School of Hygiene, Keppel Street, London, W.C.1, by February 9.

LETTERS TO THE EDITORS

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

Colour Measurement

MR. J. W. PERRY's letter on colour measurement[1] may lead to misconceptions of the nature and status of the C.I.E. colorimetric system by colour workers who have not paid particular attention to the principles of colour measurement. In stating that the numerical colour specification $\chi_{C.I.E.}$ refers to (*a*) a normal observer and (*b*) normal observing conditions, including (*c*) a field of direct observation of 2°, Perry confuses the colorimetric standard with the procedure recommended for general direct colorimetry.

The 'standard observer' is a set of tables defining what is to be understood physically by colour, and has been adopted internationally for technical and commercial purposes. There is much evidence that this standard has proved satisfactory for a large range of such applications, and we know of none where it has been definitely found unsatisfactory. But whether the present tables are satisfactory or not, they are not restricted in their application to a given field size or field brightness or pupillary aperture or otherwise.

When measurements are made by the indirect spectrophotometric method, it is clear that these factors are irrelevant. Difference in colour merely means difference in $\chi_{C.I.E.}$, and can be specified to any accuracy attainable by spectrophotometry. Perry appears to think that, owing to the procedure adopted in the experiments on which the standard system was based, there exists a possibility of error in $\chi_{C.I.E.}$ values. But there is no possibility of error in what is by definition the standard, neither is there any tolerance. The definition is exact and unambiguous. The original measurements of Guild and Wright provided evidence that a standard based on their results would probably prove generally acceptable; once the tables based on these measurements were adopted as a standard, it became irrelevant whether they represented the visual properties of the groups of observers who contributed to the results with a high or a low degree of accuracy, and whether they were obtained with a large or a small field of view. There were in fact important reasons for choosing particular conditions, but it is unnecessary to discuss them here.

The recommendations for using particular conditions in general direct colorimetry were intended to guide a real observer in his efforts to obtain measurements likely to be in satisfactory agreement with the standard observer. When very small colour differences are to be measured, it is known that different conditions of observation should be adopted. It is possible that experience in these or other measurements may show that amendments should be made in the present standards to meet the increasing requirements of technical colorimetry. But any changes will be changes of detail and not of form. No new quantity χ_N, as proposed by Perry, involving a new physical concept, is involved in either differential or absolute colorimetry with large fields. The regional variation of retinal properties is formally irrelevant to appearances in an extended field. A physically uniform field will appear uniform in colour and brightness despite retinal variations, and colour matches with such fields will result in trichromatic equations of the same form as those obtained with a uniform field of small size. The results may differ numerically but not otherwise. In both cases the numerical differences from the C.I.E. values arise from departures of the colour vision of the real observer from those defined as the standard, that is, they are to be regarded as personal errors. It is well, however, to remember that it is only advantageous to use large fields for visual colorimetry when two specimens closely alike in spectral constitution as well as in colour are to be compared; the perception of a match or of small departures from a match is then very little affected by the observer's peculiarities of vision. In these circumstances all but extremely abnormal observers will obtain results agreeing with the standard to the limits of discrimination. Thus where a large field enables greater precision to be attained usefully, any consequent tendency for colour vision to depart from the standard becomes relatively unimportant.

We believe that Perry's difficulties about the standard observer are not real. Data of this type are formally necessary and sufficient for every colorimetric problem. If modification in the standard should ultimately be found desirable in the light of accumulated experience, it will be found a purely practical matter involving no change of principle. We can see no useful purpose that would be served by the philosophical inquiry desired but, to our minds, only obscurely indicated by Perry.

T. SMITH.
J. GUILD.
R. DONALDSON.

National Physical Laboratory,
Teddington, Middlesex.
Dec. 18.

[1] NATURE, **148**, 691 (1941).

MR. J. W. PERRY's remarks[1] directing attention to the difference between the colorimetric concepts which he calls $\chi_{C.I.E.}$ and χ_N are opportune. As he points out, there is at present no real justification for applying the results of measurements made under the original standard C.I.E. conditions to problems involving other conditions of observation, and if nevertheless we do so, we must clearly realize that this procedure is at best a makeshift pending the publication of more detailed information. There is a need for fundamental research on the whole subject of the colorimetry of wide field systems.

The present position of colorimetry in the paper, printing and printing ink industry (and, I believe, several other industries) is this. If I have a sheet of paper which I have found by measurement to have colour *A*, it should be sufficient for me to order paper of colour *A* from the maker in the moral certainty that the paper, when it arrived, would match my sheet within commercial limits of tolerance; there should be no need for interchange of samples. Unfortunately, this is at present not so. Even if the paper mill and I both have visual colorimeters and they are used by experienced observers, it still does not follow that when the mill and I get identical colorimetric readings, that experimental making and sample will necessarily be a good commercial match. Of course, they may be so, and in any event they will not be *widely* different; but one cannot *guarantee* a match.

The trouble lies, of course, not in any fault in the design of our instruments, nor in a breakdown in the C.I.E. system, but in the fact that in practice the sheets are compared under conditions different from those laid down in the C.I.E. specification—conditions under which the eye is more sensitive. Further, I have taken as my example a favourable case ; but in industry the trouble is often aggravated by the use of 'colorimeters' of poor design and performance, constructed by works technicians with little knowledge of the principles of colorimetry. Now the 'practical man' in the trade tends to regard all instruments with suspicion, often, let us admit, with some justification ; and when colorimeters give the same readings when his own eyes tell him that the samples he is comparing differ appreciably in colour, no matter what the true cause of the discrepancy may be, he tends to lose faith in colorimetry altogether. This is regrettable, because if an improved method becomes available later—one which will be of real assistance to him—he will probably take no interest in it, saying that he has been 'caught' too often before. It therefore behoves one to be careful in introducing new instruments into industry.

Fortunately, as Perry points out, in many cases the papermaker would be quite happy if he had agreed colour standards to which to work, and a means of determining how far and in what directions the colours of actual makings of paper departed from these standards. What he really needs is a means of making sure that his own substandards do actually match the agreed standards, and a means of checking at convenient intervals the amount of discoloration of these substandards which may have occurred through ageing or chemical changes. This can be done conveniently and accurately by spectrophotometry, and it need not be done by the papermaker himself. The departures of different batches of papers from the agreed standards can then be studied over a limited region of the colorimetric field by means of a differential colorimeter of high sensitivity and precision, but only moderately high absolute accuracy. Photo-electric colorimeters which satisfy these conditions reasonably well are already available commercially. Until the fundamental work is done that Perry suggests, this procedure offers the best practical solution to the problem.

V. G. W. HARRISON.

Printing and Allied Trades
Research Association,
101 Princes Gardens,
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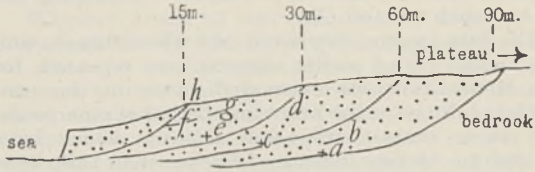
[1]NATURE, 148, 691 (1941)

Pleistocene Raised Beaches on the West Coast of Morocco

ON the invitation of the Service of Antiquities I recently spent seventeen days in Morocco, studying the very important discoveries made by R. Neuville and A. Ruhlmann in the neighbourhood of Casablanca and Rabat.

The result of their work may be summarized as follows. The coastal deposits in this region testify to four separate marine transgressions during the Pleistocene, each followed by a period of retreat. The high sea-levels have left beaches at +90 m., +60 m., +30 m., and +15 m., corresponding to the Sicilian, Milazzian, Tyrrhenian and Monastirian beaches of Depéret. On each of these rests a complex of sub-aerial deposits—consolidated dunes, freshwater limestones, red clays—formed during the succeeding period of low sea-level. The whole series of beaches and sub-aerial beds forms a complete section of overlapping layers, as shown in the accompanying diagram.



DIAGRAMMATIC SECTION OF RAISED BEACHES AND SUB-AERIAL DEPOSITS IN THE NEIGHBOURHOOD OF CASABLANCA.

Up to the present the oldest known human industry in this region had been found in and on the 30 m.-beach, and was described as "Chellean". The work carried out by Neuville and Ruhlmann in the quarry of Abd-er-Rahman, near Casablanca, now gives a much more complete picture. Immediately overlying the 90 m.-beach (*A*) they found an extensive workshop of large heavy quartzite and sandstone flakes of Clactonian type roughly worked into bifaces, usually trihedral in section. The majority were unabraded, but a few were very slightly rolled, suggesting that the falling sea had occasionally returned to the level of the workshop. The accompanying fauna included hippopotamus and rhinoceros. The beach itself yielded shells of Acanthina (to-day found on the coast of Chile). The deposit containing the implements and bones was so hard that it had to be broken up with dynamite. In the overlying sub-aerial bed (*B*) was a horizon which yielded a few untypical flakes, and on the surface of the 60 m.-beach (*C*) similar flakes were found, again in small numbers.

CORRELATION TABLE

Mediterranean Beaches	Alpine Glaciations	Industries
90 m. (Sicilian) Beach	pre-Günz	Abbevillian Clactonian
Sub-aerial deposits	Günz	Untypical flakes
60 m. (Milazzian) Beach	Günz-Mindel	Untypical flakes
Sub-aerial deposits	Mindel	—
30 m. (Tyrrhenian) Beach	Mindel-Riss	Acheulean
Sub-aerial deposits	Riss	Acheulean
15 m. (Monastirian) Beach	Riss-Würm	Micoquian Mousterian
Sub-aerial deposits	Würm	Aterian

Overlying the 60 m.-beach are consolidated dunes, in which caves have been excavated by the sea which formed the 30 m.-beach. The floors of these hollows are covered with contemporary beach material, overlain by sub-aerial clays containing animal bones, and at the contact of the two types of deposit were found bifaces of Acheulean type.

The 30 m.-beach thus fragmentarily preserved is better developed in the neighbouring quarry of El Hank, where it yielded a large Murex, which replaces the Acanthina at this level, and the industry formerly described as "Chellean". I have studied the material from this level in the collection of M. Antoine, and find that it includes two distinct industries : (1) Abbevillian (Chellean), with bifaces made on pebbles and heavily rolled; this is presumably derived from an older deposit broken up by the Tyrrhenian sea. (2) Acheulean, with typical and beautiful bifaces, some slightly rolled, but the majority unabraded. This must date from the end of the 30 m.-beach and immediately after, as in the caves at Abd-er-Rahman. Acheulean implements were also found in two dune deposits and a freshwater limestone overlying the 30 m.-beach (*F* and *G*).

The last marine deposit is the 15 m.-beach, and the history of an earlier stage is here repeated, for the Monastirian sea excavated caves in the consolidated dunes of the preceding period of emergence, and these contain sub-aerial deposits which have yielded an Aterian industry. Earlier than this, however, though slightly later than the 15 m.-beach, is a layer of red earth (*H*), which covers the sub-aerial deposits *F* and *G*, but does not belong to the same complex. This yielded Micoquian bifaces and a kind of rough Mousterian.

H. BREUIL.

Change of Pelage in the Stoat *Mustela erminea* L.

THE pelage change in captive stoats has been studied over a period of five years. The animals were caught at Ashton Wold, Peterborough, Northants, when only a few days old and hand-reared[1]. In this district the stoat normally remains brown throughout the year, although from time to time specimens are taken which show partial whitening in the winter.

Exposure to cold induced a colour change in three out of five stoats. In this particular experiment there was no artificial curtailment of the hours of daylight and no special feeding. The observations made may be briefly summarized as follows:

(1) The winter pelage may be white or brown.

(2) Captive stoats have two moults. This confirms Schwalbe's[2] observations made on wild specimens. The autumn moult occurs in late November, and the spring moult in February. The winter coat is thus carried for only three or four months. Examination of various skins shows that in northern districts the winter coat is carried for a much longer period.

(3) The date at which the autumn moult commences is generally regular, and unaffected by the temperature prior to the commencement of the moult, but the time taken for the moult to be completed is directly affected by the existing temperature. If it is low the entire moult and colour change can be effected in seventy hours. The extraordinary rapidity of the growth of the ingrowing winter coat has been demonstrated by shaving off portions of hair at this period. If the temperature is high, the moult may be spread over 10–20 days.

(4) Stoats from the same litter show great individual variation with regard to the change in colour. Exposed to similar degrees of cold, some display (*a*) no colour change, (*b*) a partial colour change, (*c*) complete colour change, (*d*) complete colour change repeated in subsequent winters, *even without renewed exposure to cold.*

(5) The degree of cold at the time of the autumn moult has a direct influence on the 'purity' or brightness of the white of the hair. When the change takes place without the direct influence of cold, but as a result of exposure to cold the previous winter, the white hair is, in comparison, of a yellowish tinge. It is nevertheless much whiter than the abdominal hairs which are normally also white during the summer.

(6) The autumn moult is always more rapid than the spring moult—the latter lasting for several weeks. It is almost irresistible to associate this with the relative suddenness of winter snow-fall and the more gradual disappearance of snow in the spring thaw.

(7) In the spring moult and in the gradual form of the autumn moult, certain well-defined areas of the body shed their hair before others. Thus, for example, the head and neck may show no sign whatever of moult of either the under-fur or guard hairs, when the rest of the body is already white. The moult commences on the underside of the belly.

(8) The moult is 'staggered' both with regard to the areas affected and the order in which the type of hair is shed. Thus the white under-fur grows in before certain of the brown guard hairs are shed. This adds to the dramatic effect of a sudden change, as the animal remains superficially brown when most of its hair is in reality white.

(9) Superimposed upon the phenomenon of the autumn moult is a limited blanching of some of the brown guard hairs before they are shed.

(10) Re-exposure to cold prior to and during the spring moult does not affect the colour of the summer coat, which grows in brown.

The frequent statements still appearing in the literature to the effect that the stoat has no autumn moult can probably be accounted for by the facts recorded in paragraph 7 and the rapidity and suddenness of the moult. The summer coat may be shed so precipitately that the hairs can be observed actually falling off as the animal moves about.

MIRIAM ROTHSCHILD.

Ashton Wold,
Peterborough.
Dec. 15.

[1] Rothschild, M., *J. Marine Biol. Assoc.*, **24**, 613 (1940).
[2] Schwalbe, G., *Morphol. Arbeiten*, **2** (3), 483 (1893).

Klino-kinesis in Paramecium

MR. YAPP'S communication on this subject[1] is of considerable interest because it suggests that temperature may be a more suitable stimulus than *p*H for making a quantitative investigation of klino-kinesis in Paramecium. A quantitative study is required to discover how completely the klino-kinesis scheme describes behaviour in gradients.

His statement[1], referring to the term *klino-kinesis*, that ". . . there does not seem to be any justification for its use, instead of the simpler term avoiding reaction, for the ordinary behaviour" calls for a reply. The special value of the term *avoiding reaction* is that it is plainly and vividly descriptive of what one sees Paramecium doing when it encounters a boundary where the intensity of stimulation changes suddenly. But Ullyott concluded[2] that the typical avoiding reaction (in Dendrocœlum) is a special case of the generalized type of behaviour in a smooth gradient, where there are no sudden changes of stimulation. If the reactions in a smooth gradient are called avoiding reactions, then this term loses its vividly appropriate character. The term *klino-kinesis* was invented[3] for the generalized reaction and intended to cover the avoiding reaction too, as it seems to do for Paramecium[4,5]; this term is further of value as part of a relatively homogeneous classification of elementary reactions[3,6]. It is worth while noticing that sensory adaptation is an essential feature of successful aggregation in the eccritic part of a smooth gradient, when a random turning mechanism is used[2,6], while it is apparently not so important at a boundary.

Mr. Yapp's conclusion would be justified, therefore, only if smooth gradients were merely "unusual experimental conditions" and sharp boundaries were the natural conditions in which "ordinary behaviour" occurred. I should have thought that in the habitat of Paramecium and on the microscopic scale involved, smooth gradients would be the rule and sharp boundaries the exception.

I agree that there need be no teleological assumption in using the term *avoiding reaction*[6]; but I suppose Mr. Yapp would agree that it would be a pity to use the term unless one could be sure that no teleological implication would be read into it.

D. L. GUNN.

Department of Zoology,
University of Birmingham.
Dec. 26.

[1] Yapp, NATURE, 148, 754 (1941).
[2] Ullyott, *J. Exp. Biol.*, 13, 265 (1936).
[3] Gunn, Kennedy and Pielou, NATURE, 140, 1064 (1937).
[4] Yapp, "Introduction to Animal Physiology" (Oxford, 1939).
[5] Gunn and Walshe, NATURE, 148, 564 (1941).
[6] Fraenkel and Gunn, "The Orientation of Animals" (Oxford, 1940).

Rapid Determination of Water in Animals and Plants

DR. L. G. G. WARNE[1] is, of course, correct in maintaining that toluene with its boiling-point of 110·7° C. is preferable to xylol (b.p. about 135° C.) in the method recently described by me[2]. Unfortunately in the work which is going on at Plymouth one has to deal with large quantities of water and it is much easier to obtain xylol at the present time than it is to obtain toluene. I would like, however, to point out that the determination of water is only a comparatively small part of the work.

A method was devised in 1938[3] by which it is possible to weigh accurately such organisms as prawns, sponges, fishes or aquatic larvæ or embryos without removing them from the water, and this has opened up a vast field for research, for having weighed the fish or sponge one can then begin to carry out a quantitative analysis. Surely it will be recognized by all that this must have a great advantage over the older method of first, more or less, drying the organism or tissue and then carrying out the analysis.

Since 1938 the technique has been greatly improved and it is possible to weigh the organisms with much greater accuracy; but, of course, it is not possible to weigh a living sponge or shrimp with the same accuracy that one can weigh a crystal of quartz or calcite, and even if one could do so the figure would be meaningless, for the weight of a living organism must alter from minute to minute if not from second to second.

The displacement method of weighing has been fully described and discussed and I trust that a full account will shortly occur in the *Journal of the Marine Biological Association.*

The method of determining the water in organisms as recently described may be of great interest in another direction, for it is well known that drying an organism either *in vacuo* or in the oven even at a temperature at which most of the tissues would be charred or largely decomposed does not remove the ***bound water*** which is of such interest in biochemistry. It is quite conceivable, however, that even the bound water is removed by distilling the tissue under xylol or toluene.

Whether I was or was not the first to apply the Dean and Stark's tube for ascertaining the percentage of water in a sponge or prawn is a matter of no concern to me, and my sole reason for publishing a short account of the method was that I was urged to do so by Dr. Joseph Needham after he had seen a Soxhlet extraction apparatus used as a Dean and Stark's tube as described in my recent communication. It appears, therefore, that the method is not too well known in biochemistry.

A. G. LOWNDES.

The Laboratory,
Citadel Hill,
Plymouth.
Dec. 21.

[1] Warne, L. G. G., NATURE, 148, 756 (1941).
[2] Lowndes, A. G., NATURE, 148, 594 (1941).
[3] Lowndes, A. G., NATURE, 141, 289 (1938).

Scientific Help for the Home Guard

MAY I through the columns of NATURE ask the technical help of readers for the Home Guard?

Although excellent equipment is now available to the Home Guard of an orthodox nature through the official channels, it still remains possible to supplement this by private ingenuity. I am inaugurating at this School a course in unorthodox weapons, gadgets and booby traps, and I would value information and suggestions from readers who have technical knowledge about how to make any of the following:

(*a*) Alarms to be attached to trip wires, etc.

(*b*) Detonators and electric circuits enabling mines, etc., to be exploded from some distance.

(*c*) Booby traps, electrically and otherwise controlled.

(*d*) Smoke bombs and methods of producing smoke screens.

(*e*) Home-made explosives.

(*f*) Home-made inflammable materials, such as the well-known phosphorus bombs.

(*g*) Home-made periscopes and other optical instruments.

(*h*) Simple signalling apparatus, buzzers, etc.

(*i*) Bird calls and other decoy noises.

In short, anything the physical or chemical properties of which can be usefully turned by the amateur to the successful harrying of the enemy. It is, of course, essential that these tools can be made by the amateur out of odd scraps of material likely to be found ready to hand. Certain of the things in the above list are for the moment prohibited, but this does not mean that it will not be worth while having at least the recipes by us in case the ban is lifted, either legally or by circumstance.

JOHN LANGDON-DAVIES.
(Capt. Commandant.)
Home Guard Fieldcraft School,
Bowmans, Burwash,
Sussex.
Dec. 30.

SCIENTIFIC AND INDUSTRIAL RESEARCH IN CANADA

THE twenty-fourth report of the National Research Council of Canada, 1940–41, includes the report of the president together with the reports of the directors of the various divisions (National Research Council of Canada. N.R.C. No. 1002: Twenty-fourth Annual Report of the National Research Council of Canada, 1940–41. Pp. 28. Ottawa: National Research Council of Canada, 1941). The former well indicates the extent to which Canada's scientific resources are being mobilized in support of the war effort. In addition to its former role the Council is functioning as a research station for the three fighting services of the Department of National Defence and also for the Departments of Munitions and Supply, and the president's report refers to the way in which the National Research Council has been able to turn its peace-time programme almost overnight into one of service in war. For example, the Section on Metrology of the Division of Physics and Electrical Engineering has been expanded to provide the organization required for gauge-testing, and to date there has been no delay whatever in dealing with this aspect of production. Similarly, the Radio Section was immediately turned to the development of secret radio communication and has made important contributions in the development of prototypes. The Section on Optics has dealt with the problem of optical glass and the manufacture of fire-control instruments, with the result that a well-equipped factory is already operating in Canada for the manufacture of optical glass and a wide range of fire-control instruments. The Section on Radiology immediately turned its attention to industrial radiology and has organized laboratories and trained personnel for inspecting castings at the various industrial plants. The Section on Electrical Engineering has been engaged on the design and production of secret gear and equipment in connexion with naval protective devices, while the Section on Acoustics has been devoting its entire attention to acoustic problems for the navy and the Section on General Physics has done much valuable work on the design of instruments, ballistics, etc.

In the Division of Chemistry the laboratories devoted to textiles, leather and rubber have been engaged in testing war materials, developing substitutes and the preparation of specifications for war materials. Research on the manufacture of ethylene glycol by direct oxidation has been continued with special reference to the stability of the catalysts. All research on methods of defence against chemical attack excepting training phases is directed by a special committee of which a member of the National Research Council is chairman and technical officers of the Department of National Defence and of the laboratories are members. This Committee has organized and directed more than twenty research projects with the various university laboratories and in the Chemistry Division at Ottawa, as well as supervised the manufacture of all the gas masks in Canada. In the Mechanical Engineering Division the wind tunnels have been engaged on many miscellaneous projects in aerodynamics, and extensive co-operative investigations on lubricating oils and fuels have been undertaken. The model-testing basin is engaged in studies in connexion with boats and floats, and considerable fundamental work has been done by the Division in the use of moulding plastic plywood construction. The Division of Biology and Agriculture has been concerned with many problems in the storage and transport of food which have become of prime importance owing to the difficulty of transport across the Atlantic. Medical research work has been carried out in close co-operation with technical officers of the Royal Canadian Army Medical Corps, and leading medical research men of Canada are working vigorously on important phases of war medicine. The National Research Council was also largely responsible for the organization of Research Enterprises Ltd., a Government-owned company formed for manufacturing certain special secret equipment from prototypes developed by the National Research Council. The report also refers to the intimate liaison established with the British Government and with research workers in Great Britain, and to the work of the Division of Physics and Electrical Engineering in selecting Canadian university men for special war service in the British Navy.

NEW SPECTROGRAPHIC OBSERVATIONS OF PECULIAR STARS

NEW spectrographic observations of peculiar stars were discussed by O. Struve and P. Swings, of the McDonald and Yerkes Observatories, at the Autumn Meeting of the U.S. National Academy of Sciences held during October 13–15. The McDonald Observatory of the University of Texas (which is operated jointly by the University of Chicago and the University of Texas) is equipped with a powerful ultra-violet spectrograph. Two large crystal quartz prisms and lenses of quartz or of ultra-violet glass transmit stellar radiations to the limit imposed by the ozone bands in the atmosphere of the earth. During the past two and a half years this instrument has been used to record the spectra of a number of peculiar stars which had heretofore been investigated only in the ordinary photographic region of the spectrum. The ultra-violet region of the spectrum contains many important features: the limit of the Balmer series falls in the near ultra-violet where the lines crowd together and where photo-electric ionizations produce a marked discontinuity in the distribution of the continuous spectrum.

Among the results obtained are several remarkable cases of changes in the spectra. Perhaps the most spectacular case is that of γ-Cassiopeiæ, which a few years ago was a normal emission line *B* star, and which in 1940 had an almost pure absorption spectrum with very sharp lines, while at the present time the absorption lines are broad and very diffuse. We know that the emission lines come from a tenuous shell around the star. For some, as yet, obscure reason the shell began to change a few years ago. The authors suspect that it started closing in towards the star, producing an intermediate stage spectrum of sharp lines. Finally, early in 1940, the shell must have largely fallen into the reversing layer of the star.

The opposite series of events has taken place in several other stars (*Z* Andromeda, *AG* Pegasi), where a new shell recently formed has expanded and has, in the case of *Z* Andromedæ, progressed from the sharp-line absorption spectrum to an almost pure emission spectrum.

These examples show that the processes of evolution in astronomy are not always imperceptibly slow. The outermost layers of stellar atmospheres are extremely unstable formations which often undergo marked changes in a few weeks or even days. Apparently these formations are supported by a delicate balance of three forces: gravity downward, towards the centre of the star, radiation pressure from the brilliant continuous spectrum of the photosphere directed outward, and radiation pressure within the Lyman alpha line of hydrogen from the tenuous shell. This latter force is directed inward in the deeper regions of the atmospheric shell, and outward in the outermost regions. A small disturbance of the balance of these forces causes the entire structure to collapse, if gravity predominates, or to expand, if the outward components of radiation pressure predominate.

USE OF SNOWFLAKE REPLICAS FOR STUDYING WINTER STORMS

By VINCENT J. SCHAEFER

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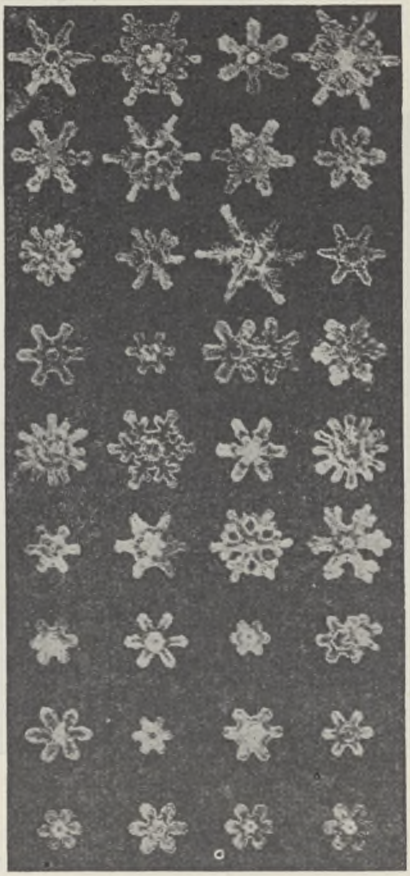
A METHOD was described last winter by me[1,2] for making permanent replicas of snowflakes, ice crystals and other forms of evanescent objects. The technique, in brief, is to cover the frozen object with a cold dilute solution of an appropriate resin dissolved in a suitable solvent. After the solvent evaporates, a very thin continuous film reproduces in intimate detail all the surface configurations of the specimen. The substance of the original object is then removed by sublimation or by melting and evaporating, after which the resin shell, which optically appears identical to the original object, may be photographed and studied at leisure. A 1–2 per cent solution of polyvinyl formal[3] dissolved in ethylene dichloride (1–2-dichloroethane) reproduces excellent replicas of snowflakes and other forms of frozen moisture.

For collecting snowflakes a piece of black velvet stretched on a board is used to catch the specimens. A small drop of the resin solution is placed on a glass slide with a tapered rod. The rod, which still retains a small amount of the resin solution, is then immediately brought into light contact with the selected specimen and the flake readily adheres to it by surface tension. The specimen leaves the rod when it is brought into contact with the drop of liquid on the slide. All equipment is kept outdoors in a sheltered place throughout the winter.

Since the method of making permanent replicas is so simple, it would seem that those interested in winter weather phenomena might secure specimens from various types of storms for detailed study of these fascinating frozen forms in their possible relation to later meteorological occurrences. To illustrate these possibilities, the thirty-six photomicrographs reproduced herewith were obtained in a thirty-minute fall of large snow crystals at Schenectady, New York, U.S., during 7.00–7.30 a.m., March 12, 1941. During this short period, 150 specimens were collected and of these the 36 photomicrographs reproduced represent a typical cross-section of the replicas obtained. In securing these specimens the collecting board was cleaned every few minutes to make sure that representative crystals were secured throughout the fall. The photomicrographs were all made at the same magnification, so that the change in size as well as form can readily be seen in the photograph.

The climatic conditions when the specimens were collected showed a falling barometer at 29·70 in., a temperature of 26° F. with a north-west wind blowing. As happens frequently in this section of the United States, the crystal fall of large symmetrical crystals occurred at the close of a storm which deposited a total of about ten inches of snow. The snow of the storm contained a large amount of water (0·09 in. water per inch of snow) so that we would term it a 'wet' snow. At 7.30, when I stopped collecting, the symmetrical crystals were replaced by the more common non-crystalline forms of assymetrical flakes which continued for several hours, after which the wind changed and the skies cleared. It will be noted that the crystals collected at the start of the fall had a considerable amount of secondary deposits which gradually disappeared as they decreased in size and changed in form.



Other forms of frozen precipitation such as sleet, graupel and ice crystals, terrestrial forms such as columnar and tabular frost, as well as breath patterns and crystals of low melting point such as benzene and acetic acid may all be prepared in replica form by the method described.

[1] *Science*, 93, 239 (1941).
[2] *Museum News*, 19, No. 6, p. 11 (1941).
[3] Shawinigan Prod. Corp. Shawinigan Falls, Ontario, Canada.

SHOOT APEX IN GRASSES AND CEREALS

By DR. B. C. SHARMAN
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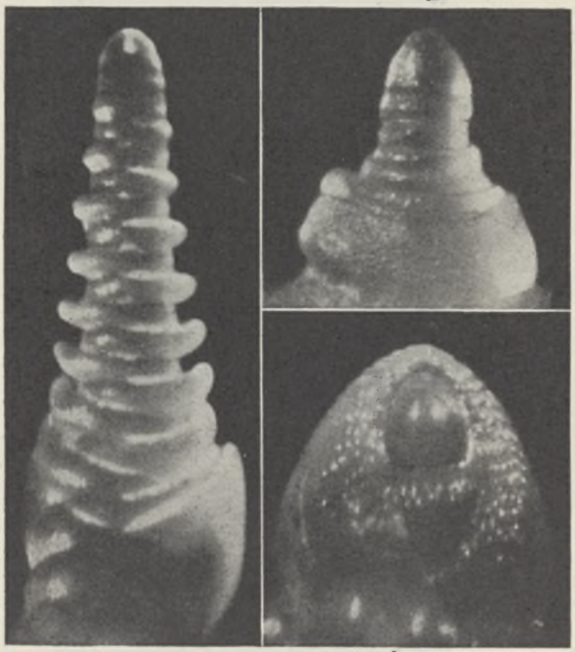
THE lack of readily available illustrations and literature on the morphology of the shoot apex in the Gramineæ, coupled with the fascination to be obtained from actually viewing the living growing point and the newly initiated primordia in various stages of their early development, prompt a note for the benefit of other workers. Using a mounted needle under a fixed lens (or for preference, a dissecting-microscope) a little care will enable the outer leaves of most grass shoots to be removed one by one until the very young primordia and the growing point are revealed. Of the grasses so far studied, *Glyceria fluitans* R.Br. is by far the easiest to dissect, since its leaves are conduplicate and possess little sclerenchyma, etc., so that the tissues cut exceptionally well and yield to the needle in a manner curiously reminiscent of snow.



× 100 approx.

Figs. *A*, *B* and *C* show vegetative apices of *Lolium multiflorum* Lam., *Glyceria fluitans* R.Br. and *Triticum vulgare* Host obtained in this way: the photographs, however, do not adequately convey their delicate translucent appearance. In Figs. *A* and *B* the apices are viewed perpendicularly to the plane of the leaves, so that the young primordia are seen arising alternately on the right and left of the axis as small crescentic protuberances some little way back from the actual tip. In Fig. *A* two young leaves at the base of the apex have been removed because although they did not obscure the tip, they did hide the lower primordia. For a similar reason in Fig. *B* a single basal leaf was removed. In Fig. *C* the apex is viewed in the plane of the leaves, one primordium being seen overtopping the apex while a younger one is partly exposed to view: a still younger one was found on further dissection.

Although at the outset the initiation is comparatively localized, it soon spreads around the apex so that a more ring-like structure is produced giving rise to the encircling insertion so typical of grass leaves. The primordium grows fastest in the region of its origin, and thus after a while appears as a small cowl growing over the tip and enclosing the younger leaves (see Fig. *C*). In vegetative shoots the buds are formed in the axils of the leaves after they have reached this stage and are leaving the immediate proximity of the apex.

The lengths of the apices vary considerably, species in the same genus often having apices of very different dimensions, but those of individuals of any particular species are usually of about the same length, especially if shoots of equivalent stages are examined. It is difficult to find a natural measure to express the length of the apex when comparing one with another. A useful ready method of comparison is obtained by counting the number of successive primordia from the youngest until one is reached which is sufficiently well developed to enclose the youngest leaves and overtop the stem tip. When the apices of a number of species are compared, it is seen that they can conveniently be divided into the following three groups, although a number of intermediate forms can always be found:

(1) A long type where some 12–20 or more young primordia are maintained as in *Lolium multiflorum* (Fig. A). Bugnon[1] in a longitudinal section shows eighteen primordia on the apex of *Melica altissima* L. which might well come here. In this group there seems to be much variation, more vigorous shoots having considerably longer apices than weaker or less mature ones. There seems to be a continuous lengthening of the apex up to the onset of inflorescence production, when buds appear in the axils of primordia which do not yet overtop the apex and have not left the apical region. Bud development rapidly becomes more precocious and the early growth of the primordia slower until the buds are the conspicuous feature and the subtending leaves no longer excite notice.

(2) In the intermediate type, which is not sharply delimited from type (1) and perhaps ought to include it, there are about 5–10 primordia on the apex as shown in Fig. *B* for *Glyceria fluitans*. This is by far the commonest type and includes most of the herbage grasses (for example, it is found in Agropyron, Anthoxanthum, Arrhenatherum, Dactylis, Holcus, *Lolium perenne*, Phalaris, Phleum[2] and *Poa annua*). Although more vigorous shoots usually have longer apices, in general the limits for each species are more clearly defined in this group, especially in types tending to have rather shorter apices. There is some increase in the number of primordia borne as the shoot matures, but at the onset of inflorescence production considerable elongation occurs (cf. Evans and Grover[2], and Weber[3]) accompanied by an accelerated bud production exactly as in type (1).

(3) In the third type the apex is very short (Fig. *C*) and commonly bears only one or two leaf primordia. Avena[4,5], Coix, Hordeum[5], Oryza, Secale[6], *Sorghum sudanense* Staph., Triticum and Zea as well as *Phyllostachys nigra* Munro[7] and Saccharum have apices of this type. It is prevalent in the cereals but is not limited to them. Typically, the apices remain short during the vegetative period and only elongate rapidly and suddenly at inflorescence production

when the axillary buds arise precociously, giving the appearance of double protuberances formed from the buds and the subtending primordia which remain as crescentic ridges (Purvis[8] and Bonnett[5]). This sudden elongation is very marked in Zea: in Triticum, on the other hand, there is a slight tendency to apex elongation during the initiation of the last three or four vegetative leaves.

It has been suggested[9] that apices of the short type are characteristic of annuals and that perennials tend to have the longer types, but the occurrence of short apices in Phyllostachys and Saccharum, and of long apices in *Poa annua* and *Lolium multiflorum* are not in accordance with this. Nor can the type of apex be correlated with a monocarpic or polycarpic habit since although many (? most) bamboos of the genus Phyllostachys (see Kawamura[10]) die after flowering, this is not likely to be the case in Saccharum when it does happen to flower. Again, although *Lolium multiflorum* is a type with a long apex, after it has flowered a clone can often only be maintained with difficulty.

Nor does there appear to be any connexion between the degree of tillering and the type of apex. Coix, Phyllostachys, Saccharum and winter wheat all tiller well but have short apices. In a number of strains of maize with a more pronounced tillering characteristic, kindly sent by the Maize Genetics Coöperation of Cornell University, the apices were indistinguishable from normal non-tillering types.

The clue to the length of the apex probably lies in the behaviour of the provascular strands. If these are initiated early in the primordium and rapidly link up with the system lower in the stem, then early in its development the young leaf and its portion of the apex will be able to tap food supplies coming back from older leaves, and thus be able to grow rapidly so that it soon encloses the younger leaves and overtops the stem tip and at the same time is removed from the extreme growing region. In cases where the development or the linking up of the provascular strands is slow, there will be a 'piling up' of primordia and the consequent production of the long type of apex.

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INFLUENCE OF TEMPERATURE AND *p*H ON THE C/N RATIO OF SOILS

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WITH ordinary soils the results obtained in different countries show that as a rule the higher the mean temperature of the soil the greater is the carbohydrate/nitrogen (C/N) ratio. Dhar and Mukherji[1] have reported that in India the C/N is highest in the soils from the Punjab with the average value of 14·4, in the United Provinces it is 11·3, in Bihar it is 9·2 and in Bengal the ratio is 9·1. In Wales it is 9·2. In the State of Washington after long cultivation the value is 10·2. In the Sudan it is 12·6 and in the Transvaal it is 14·4. It seems, therefore, that the C/N ratio of normal surface soils is in general an indication of the average temperature of a locality.

Experiments carried on by Dhar and Mukherji, in which normal garden soil samples collected from Allahabad, with a C/N ratio of 10·1, were kept in an air oven at 80° for more than two years, showed an increase in C/N with time from 10·1 to 13·5.

These results of Dhar and Mukerji showing that the C/N ratio increased in normal soils with increase of soil temperature are in agreement with those obtained by McLean[2] but are contrary to those calculated by Jenny[3].

In alkaline soils collected from Soraon and Saidabad near Allahabad and from other places like Bangalore (Mysore) it is observed that the C/N ratio of such alkaline soils is small and varies from 4·0 to 7·5.

*p*H	C/N
(*A*) Soraon and Saidabad (Allahabad) Soils (0–9 in. depth)	
10·4	4·0
10·5	4·9
8·4	6·1
9·3	6·8
(*B*) Bangalore Soils (0–9 in. depth)	
9·8	6·7
8·0	6·7

When these alkaline soils are treated with reclaiming agents like molasses and press-mud or oil cakes the C/N ratio tends to increase as in normal soils. These results seem to be highly interesting, and show that alkalinity favours carbohydrate and cellulose oxidation more than protein metabolism. Alkalinity thus seems to oppose the influence of temperature on the C/N ratio of soils. Moreover, this small ratio of C/N in alkaline soils makes it clear that ammonium compounds do not occur in large quantities in such soils and the nitrogen store in soils may be the more complex protein compounds which do not undergo oxidation in the alkali soil as readily as carbohydrates and celluloses.

On the other hand, in soils where there is a tendency for the generation of acids, as in most cold countries, the C/N ratio should have a tendency to increase. In other words, in soils where the *p*H range is smaller than 7, it is expected that the protein oxidation would be favoured more than the oxidation of cellulose and carbohydrates. This conclusion is fairly well supported by the following observations on C/N ratio of acid soils in different countries.

The *p*H of soils collected from different countries are as follows:

Scotland	5–6·4
Finland	5–6·4
Japan	4·5–6·9
Denmark	6–6·9
Sweden	6–7·4
Java	6·5–7·9
Egypt	7–9
North India	7–10·8

It may be seen from the above data that, in general, the soils of cold countries have a tendency to acquire a lower *p*H value than those of warmer countries. The *p*H of some of the soils collected from different cold countries is given in the table below against the C/N ratio of such soils.

In Siberia some soils show a C/N ratio of 13·6.

It seems that two opposing factors are at work in controlling the C/N ratio of soils. In tropical countries,

	pH	C/N	Depth	Place	Investigators
Red Loams	6·4	18·30	0–6 in.	Chaubatia (Kumaun Hills), India	Mukherji and Das
I	6·8	14·20	0–6 in.		
Brown	6·2	18·20	0–8 in.		
Forest	6·3	12·70	0–1 ft.		
Soils II	6·5	18·90	0–5 in.		
	6·8	16·10	0–5 in.		
	6·2	19·04	0–1 ft.		
Podsol	6·8	16·60	0–7 in.		
III	6·0	16·90	0–1 ft.		
Wiesen-	6·4	16·0	0–6 in.		
boden IV	6·7	15·84	0–9 in.		
Podsol	3·70	29·24	6–9 in.	Shropshire, England	Davies and Owen[5]
V					
	3·13	13·36	9–19 in.		
	3·73	23·48	19–23 in.		
Podsol	3·0	129·0		Northern New Guinea	Hardon[6]
VI	4·3	51·69			
Brown	5·26	24·60	0–10 cm.	England	Muir[7]
Earth VII	5·35	19·40	20–30 cm.		
Brown	6·17	23·96	0–3 in.	Saskatchewan, N. America	
Plains	6·20	29·00	3½–7½ in.		
Solod	7·07	21·90	7½–9 in.		

due to the influence of light and high temperature, the organic matter, which acts as a buffer, is readily oxidized from the soils, which have thus the tendency to be alkaline. With such soils, before the alkalinity is reached, the C/N ratio has a tendency to increase as observed by ourselves as well as McLean. But as alkalinity develops, the cellulose and the carbohydrates are oxidized more readily than the protein of the soil and the C/N ratio falls off. Hence the temperature effect is nullified by the alkalinity influence.

On the other hand, in soils in temperate and subtropical countries the organic matter added to the soil or present therein is not oxidized readily and hence such soils have a tendency to be on the acidic side, as illustrated above. But before it becomes acidic the C/N ratio may be in the neighbourhood of 10·0, as is frequently observed. But when the soil becomes acidic, the C/N ratio tends to increase. This is because in protein metabolism, ammonia is usually the first product of such oxidations and hence acidity may help the removal of one of the products of protein oxidation, namely, ammonia, and thus may help protein metabolism. Hence, in acid soils. protein metabolism may be faster than the oxidation of cellulose or carbohydrates, resulting in the increase of C/N ratio of such soils. This is why Jenny has obtained high C/N ratios in soils from cold countries.

The above conclusions are supported by the observations of Jensen[8] showing that 20–25 parts of carbon are oxidized in the nitrification of one part of nitrogen nitrified in acid soils, and by the facts that the acid soils in the paddy fields of Siam have 11·4 as the C/N ratio and the C/N ratio of virgin or prairie soils falls off from 13·6 to 10·5 after cultivation as observed in the United States and that the C/N ratio of Mauritius soils increases with increasing rainfall and soil acidity as recorded by Craig and Halais[9].

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[2] McLean, *J. Agric. Sci.*, **20**, 340 (1930).
[3] Jenny, *Soil Sci.*, **27**, 168 (1929).
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[7] Muir, *Forestry*, **8**, 25 (1934).
[8] Jensen, *J. Agric. Sci.*, **19**, 71 (1929).
[9] Craig and Halais, *Emp. J. Exp. Agric.*, **2**, 349 (1934).

FORTHCOMING EVENTS

Monday, January 19

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. B. A. Keen, F.R.S.: "Soil Physics, Theory and Practice" (Cantor Lectures, 1).

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Dr. Kenneth Sandford: "Western Frontiers of Libya".

Tuesday, January 20

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Prof. Ellis H. Minns: "Archæology in the U.S.S.R.".

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Rev. H. M. Grace: "Educational Problems of East and West Africa".

Wednesday, January 21

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. James Kewley: "Evolution in the Petroleum Industry".

Thursday, January 22

TOWN AND COUNTRY PLANNING ASSOCIATION (in the Dome Lounge, Dickins and Jones, 224 Regent Street, London, W.1), at 1.20 p.m.—Prof. Patrick Abercrombie: "Re-Development of City Centres".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. C. E. Inglis, F.R.S.: "Aesthetics of Bridge Design".

Friday, January 23

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. Brian Reed: "The Future of the Railway Oil Engine".

Saturday, January 24

BRITISH RHEOLOGISTS' CLUB (in the Department of Physics, The University, Birmingham), at 1.15 p.m.—Discussion on "Classifications of Rheological Properties".

APPOINTMENTS VACANT

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

LECTURER IN PHARMACEUTICAL SUBJECTS at the Plymouth and Devonport Technical College—The Education Office, Cobourg Street, Plymouth (January 28).

HEADMASTER of the Junior Technical School of the Royal Technical College, Salford—The Director of Education, Education Offices, Salford 3 (January 31).

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Psychological Society. Shelter and Evacuation Problems: being Papers read at a Meeting of the Society held on July 26th, 1941, and a Short Summary of the ensuing Discussion. Pp. 32. (London: British Psychological Society.) [1612

International Committee for Bird Preservation, British Section and Polish Section. Annual Report for 1939 and 1940. Pp. 32. (London: International Committee for Bird Preservation.) [1612

National Baby Welfare Council, including National Baby Week Council, 1941. Annual Report, 1939–40. Pp. 12. (London: National Baby Welfare Council.) [2412

Other Countries

Dominion Observatory Bulletin No. R.26: Report for the Year ended 31st December 1940. Pp. 4. (Wellington: Government Printer.) [2412

Government of Madras. Administration Report of the Government Museum and Connemarra Public Library for the Year 1940–41. Pp. 32. (Madras: Government Press.) 8 annas. [2412

Indian Forest Records (New Series). Botany, Vol. 2, No. 3: *Hopea shingkeng* (Dunn) Bor. By Dr. N. L. Bor. Pp. ii+227–230+1 plate. 6 annas; 7*d*. Botany, Vol. 2, No. 4: Some New Indian Flowering Plants: *Gleditsia assamica* Bor, *Garnotia puchiparensis* Bor, and *Strobilanthes andamanensis* Bor. By Dr. N. L. Bor. Pp. iii+231–240+3 plates. 14 annas; 1*s*. 3*d*. (Delhi: Manager of Publications.) [2412

Annual Report on Forest Administration in Malaya, including Brunei, for the Year 1940. Pp. ii+22. (Kuala Lumpur: Government Press.) 1 dollar; 2*s*. 4*d*. [2412

Department of Agriculture: Straits Settlements and Federated Malay States. Economic Series, No. 12: Malayan Agricultural Statistics, 1940. By D. H. Grist. Pp. xii+106 Tables. (Kuala Lumpur: Department of Agriculture.) 1 dollar. [2412

Report on Agriculture in Malaya for the Year 1940. By W. N. C. Belgrave. Pp. 14. (Kuala Lumpur: Government Press.) 1 dollar; 2*s*. 4*d*. [2412