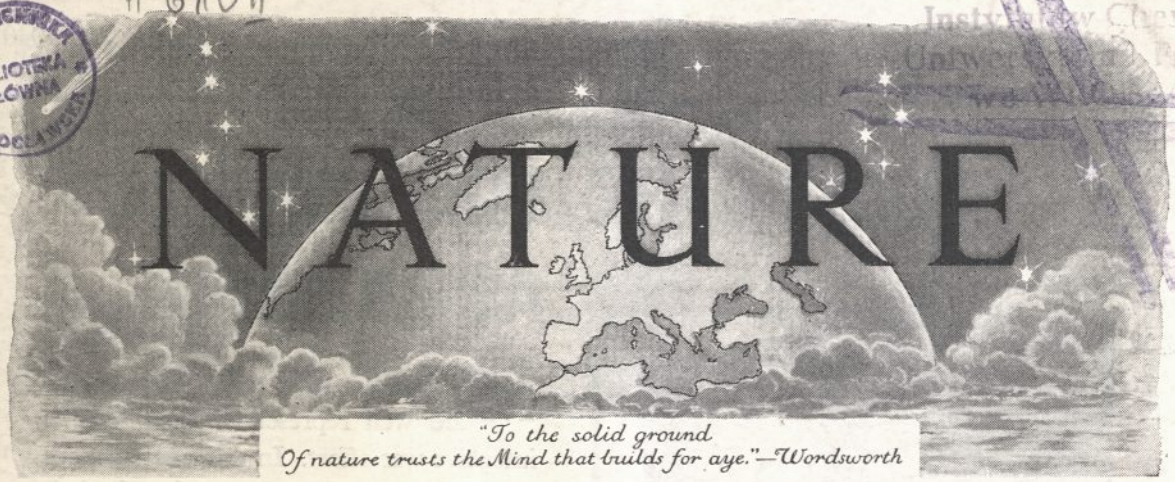

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FRENCH MEN OF SCIENCE IN BRITAIN

THREE weeks ago, we expressed the hope that some French scientific workers would succeed in reaching Great Britain. This hope has been realized and we are already in touch with some of them. At the time of the capitulation of their country, some were already in Great Britain ; some left southern France just in time ; others escaped, in more or less dramatic circumstances, from that part of their unhappy country now occupied by the enemy. At present, they are not a large body, but they hope, and we hope with them, that they may be joined by others who may follow in the future.

These French scientific workers have not come to Great Britain to seek refuge. They have come because they felt it was a duty to keep their place in the fight—in the fight that Great Britain is now facing alone ; they came because they still felt themselves tied to Great Britain by the solemn oath of France. They have been faithful both to their own ideals and to Great Britain. They have brought not only their readiness and their skill, but also information which will be of much service in Britain's war effort. General de Gaulle understood immediately the importance of this fact, and M. Labarthe has been appointed to take charge of the "Armaments and Scientific Research" Department of the French National Committee. So far as scientific research is concerned, the role of M. Labarthe's department will be to put the French men of science into touch with appropriate English laboratories, in order to ensure the best utilization of their skill in whatever branch of scientific or industrial research they are specially competent.

It is obvious that these French men of science cannot be allowed to enter laboratories where certain war research is going on, and we are sure that they themselves appreciate this fact. We hope, nevertheless, that they will not be prevented from joining the British war effort just because they are not British. They should certainly not be treated as enemy aliens ; indeed, the Government's offer of a month ago of complete union with France might be renewed in their case, and they might be allowed to obtain British nationality, at least for the duration of the War.

Some of the French men of science have special knowledge in branches which have no direct connexion with the war effort. They should find in the universities of Great Britain a friendly welcome, and the opportunity of continuing their researches in that atmosphere of freedom which is so necessary for creative scientific work.

Those who worked in France on war research are anxious to resume their labours in Great Britain. But they are fully aware that there may be little opportunity for long-distance research ; they are ready to do any work in which they can be useful, even if it is in the nature of industrial routine ; and are prepared to take part in active defence measures in case of emergency.

The French scientific workers who have succeeded in reaching Great Britain are eager to help us in our war effort, and we must in our turn help them in every possible way. In the muddle and turmoil of the moral and military collapse of France, they have put aside all family and other ties, and have left their country in order to carry on the struggle for the ideals of democracy in which they believe. It would be but a small return for us to set them to work as soon as possible, so that they may be spared the anxious thoughts which must inevitably occupy their inactivity.

A PSYCHOLOGICAL 'HINGE' IN NATIONAL DEFENCE

JUST as German strategy concentrated on a weak hinge in the military defences of France, so in its general technique of invasion the German Command thrusts at what may be called a psychological hinge in the national defences : the weak point where military discipline ends and civil organization begins. Invasion by parachute troops co-operating with secret agents is the most dramatic form of the attack on this weak hinge. Its success in the neutral countries depended on military operations being carried out in an area which was still organized for civil life and looking to civil authority for direction. Military attack at that point in the national structure caused panic and confusion.

In Great Britain we hope that forewarned is forearmed. The question is, against what exactly have we been forewarned ? Against parachute invaders aided by secret agents ? But quite different tactics might be employed and yet fulfil the same military purpose through having the same fundamental effect psychologically.

This effect can perhaps be best described as a form of bewilderment. It results from the sudden shattering of deep-seated assumptions and expectations which the civilian—and possibly the soldier too—harbours about warfare. These assumptions are partly expressed in the formulated laws and usages of war. But the most important, psychologically, spring from less definite factors, such as custom, long-sanctioned sentiment, tradition ; or, in more modish guise, from the prevailing 'cultural patterns'. The German policy is to disrupt those patterns, and to take advantage of the resulting bewilderment.

One of our clearest cultural patterns—so long established as to seem 'natural'—is that of a strict differentiation of the military function within the community, with a specialized sub-group to perform it. Without this pattern there would be no foundation for the laws governing the treatment of non-combatants in warfare. This pattern has persisted up to the present time. Bombing from the air, it is true, brings civilians within range of military dangers and does something to blur the distinction between soldiers and others. Yet in its psychological effects the bombing we have experienced in Britain has been in some ways more like a natural calamity. It has been an ordeal in which the civilian has remained comparatively inert, passively enduring.

The psychological effect seems to be very different when the enemy's parachute troops are actually among civilians, carrying out a military attack against communications and transport in areas where ordinary civil life is the rule. If, in addition, low-flying aircraft deliberately machine-gun civilians in order to cause confusion, the sense of a personal attack is enhanced. Such attacks represent a much more intimate infiltration of military purposes into civilian life than aerial bombing has done in the past. The enemy is using his attack on civilians for a direct and immediate military purpose, that of hampering the army's operations by means of civil confusion.

Yet the civilians remain civilians. They have no training, no equipment, and no organization for resisting, and—what may be worse—they have no clear right even to resist by armed force.

The blurring of established social patterns is carried further in the use made by Germany of secret agents. The so-called 'Fifth Column' in the invaded countries has engaged not merely in espionage and sabotage, but also in actual military co-operation with enemy troops. Against these agents, presumably, even civilians would be entitled to use any force that they could. This seems to be implied in the official leaflet "If the Invader Comes", when it instructs factories to organize their own system of defence against sudden attack :

"If you are in charge of a factory, store or other works, organise its defence at once. If you are a worker, make sure that you understand the system of defence that has been organised and know what part you have to play in it. Remember always that parachutists and fifth column men are powerless against any organised resistance. They can only succeed if they can create disorganisation. Make certain that no suspicious strangers enter your premises."

Examined carefully, the official wording here (and throughout the leaflet) can be seen to avoid giving sanction to armed action by civilians against parachute troops. The caution and vagueness of official pronouncement reflect the central difficulty : that of securing safety while still adhering to the usage of war in totally novel circumstances.

The Local Defence Volunteers represent the main attempt in Great Britain to meet this difficulty. They form the answer to a ruse which takes advantage of laws and customs that grew up in totally different circumstances from those created by the German strategem. The ban on the *franc-tireur* was based on the experience of armies of occupation which were in full military control of enemy territory. What were not envisaged were acts of brigandage by small bands of troops within territory the ordinary military defences of which are still intact. The enlistment of Local Defence Volunteers succeeds in maintaining the clear difference in military law between the soldier and the civilian, but it leavens the civilian population with men equipped for military functions and entitled to exercise military rights.

The fundamental answer to the German policy, however, has not yet been discovered. Full defence against the policy of social confusion can consist in nothing less than restoring psychological clarity to the situation. The secret agent was effective in countries where his own clear-cut intentions contrasted with the divided sympathies and faltering policy of those around him. In the Netherlands, it is reported, the 'Fifth Column' organizations were perfectly well known but were not proceeded against for fear of provoking Germany. In Britain, on the other hand, clarity of national intention should now be more easily achievable. Given that, police action, with the co-operation of the public, can handle the danger of the secret agent.

Against parachute invaders the precautions must in the main be military. Yet here the importance of the psychological 'hinge' can too easily be under-estimated and neglected. A civilian population untempered by military training and yet exposed to military attack presents a problem which has not yet been fully solved. The German politico-military Command has deliberately disrupted the older social patterns. Diplomatic pressure, military assault, brigandage, espionage, treachery, revolution, these are all familiar. But in the past they have been clearly distinguishable from each other. Now, however, the separate patterns have been dissolved and the new situation is a bewildering social hybrid. It remains bewildering so long as we try to grasp it in terms of the older patterns. In particular, the complete gulf between the civilians and the armed forces is an anachronism.

Up to the present, the policy of the army has been to work in the greatest possible isolation from civilian life. The civilian has been encouraged to cultivate total ignorance of the meaning of any military activity that cannot be entirely concealed from him. It should scarcely need technical psychology to make it clear that this policy will *not* prevent gossiping, rumour-mongering, and the spread of all manner of alarms and forebodings. Again, the policy towards civilians in a battle area has been the negative one of either evacuating them or of keeping them immobile and inert. But when battle areas are no longer neatly delimited, and new tactics make civilian panic much more likely, this policy is not certain of success. Moreover, it ignores the fact that the army may require much more positive co-operation from civilians.

The new circumstances make it dangerous for the army to persist in regarding civilians as nothing but an unavoidable nuisance. It would seem that the weak hinge between civil life and military organization must be strengthened. Much could certainly be done by the military authorities, without any leakage of vital information, to give the impression of taking the public into their confidence far more than they do at present. The leaflet "If the Invader Comes" makes it clear that the co-operation of the civilian public may be needed by the army authorities. Any more detailed expansion of the bare hints dropped by that leaflet would do something towards strengthening the weak hinge.

Many methods could undoubtedly be found of implementing such a policy if it were accepted in principle. There would be value even in so obvious a device as lectures to civilian audiences dealing in a general and non-committal way with the strategy and tactics which we may at any moment find ourselves involved in. Broadcasts have done a very little in this direction. In some ways, lectures given by military men in the actual presence of small civilian audiences would be more useful. They could have more local relevance. They would give more visible reality to the contact between civilians and military authorities.

The fact is that at present, to a great proportion of the civil population, a military officer on duty is psychologically foreign. This was of little account when wars were fought on a front line. In the new circumstances of war it is more serious. It represents a danger which can probably be met only by giving the civilian population a more visible, more local, and more definite role in their support of those who carry out the specialized military function.

SCIENCE IN ITS INFANCY

Science and the Classics

By Sir D'Arcy W. Thompson. (St. Andrews University Publications, No. 44.) Pp. viii + 264. (London : Oxford University Press, 1940.) 5*s*. net.

THIS dainty little book, elegantly produced by the Oxford University Press, does not pretend to be a history of science in classical times. Sir D'Arcy Thompson did not but collect in it twelve lectures delivered by him on different occasions from 1910 until 1935 (a distinguished jubilee), and connected with various aspects of science, as it was conceived and understood in this remote period, when the foundations of science were laid.

Sir D'Arcy Thompson, after winning a well-earned holiday from a laborious and long scientific and scholarly life, remembered the Greek motto which he quotes :

ἃ δ' ἂν μάθητις ταῦτα, σώζεσθαι φιλεῖ πρὸς γῆρας

and which he interprets in his own felicitous manner, by saying :

> "Science and the Classics ! The one says (in Wisdom's words) : They that eat of me shall yet be hungry. And the other says : They that drink of me shall yet be thirsty. And both alike continually enlarge our curiosity, and multiply our inlets to happiness."

Nevertheless, this book, composed in a restrained scope and scattered form, by a man to whom I should like to apply the Sophoclean verse :

φῦναι τὸν ἄνδρα πάν' ἐπιστήμης πλέων
(The man being full of knowledge)

constitutes a valuable contribution to the theme.

We are accustomed to look to classisism and its productions, not so much for scientific speculations and achievements, as for the highest pleasure of intellect, triumphs in expression of the human mind, or the enjoyment of impeccable forms, all attained sometimes, but never surpassed, by moderns.

Sir D'Arcy, however, teaches us that many of the classics we love and admire were interested in purely scientific speculations. As he puts it admirably : "It has been the rule from time immemorial, not the exception, for science and the humanities to go hand in hand. Aristotle the naturalist wrote of poetry ; Plato was a lover of astronomy ; Theophrastus the botanist was a master of rhetoric, whom even Cicero admired ; Celsus the physician was an encyclopædic scholar after the taste and fashion of his age. When the humanistic tradition was at its height in the 'revival of learning', Galen and Hippocrates were read by all". May I add that Ptolemæus, the great man of science of the second century A.D., who founded the Ptolemaic system and was a writer on astronomy, chronology, geography, and music, in the elation for his work as an astronomer, composed the well-known epigram in which he compares himself, for exultation and pleasure, to a god—no less than Jupiter. This epigram, which I expected in vain to find quoted in Sir D'Arcy's chapter entitled, "Astronomy and the Classics", runs as follows in the translation of F. L. Lucas :

> "I know well I am mortal, a feeble thing and fleeting ;
> Yet when I watch the wheelings of myriad star on star,
> My feet touch earth no longer. It is as I were eating,
> At the high God's own table, of Heaven's ambrosia."

Sir D'Arcy, following the examples he mentions, combines the status of a distinguished naturalist with that of a prominent classical scholar, and it is to this happy combination to which we owe first his great work, "The Glossary of Greek Birds", and now the present little volume of "Analecta", a fruitful wandering among the flower-beds of classical gardens and the more austere alleys of scientific speculations.

The chapter, "Aristotle the Naturalist", he compiled with a special interest, as this great Greek, being a philosopher and a writer on the most various of subjects, also distinguished himself as a naturalist, and thus it may be said that Sir D'Arcy has in some ways claims analogous to those of Aristotle.

I find in this chapter, with an understandable pleasure, the confirmation of what I tried to explain in regard to the description of Nature in Greek poetry, when reviewing lately, in these columns, Dr. Soutar's book (NATURE, April 27). It is so much more strikingly expressed by Schiller, whom Sir D'Arcy quotes, that I cannot but yield to the temptation of transcribing herewith the passage :

> "As Schiller puts it, the Greeks looked on Nature with their minds more than with their hearts, nor ever clung to her with outspoken admiration and affection ; and Humboldt, asserting (as I would do) that the portrayal of

Nature for her own sake and in all her manifold diversity was foreign to the Greek idea, declares that the landscape is always the mere background of their picture, while their foreground is filled with the affairs and actions and thoughts of men. But all the while, as in some old Italian picture—of Domenichino or Albani or Leonardo himself—the subordinated background is delicately traced and exquisitely beautiful; and sometimes we come to value it in the end more than all the rest of the composition."

Sir D'Arcy has a system of his own, which he seems to recommend to others—although those who may follow his example must have the extent of his interest in reading and taste for choice. He takes note-books, he labels them according to a specified subject, and fills them with quotations, remarks and thoughts. To one of these note-books we owe the charming chapter under the title: "Games and Playthings". Sports and toys seem to have but a remote relation with science. Nevertheless, games have their science, and toys, even in those times to which Sir D'Arcy refers, have sometimes a scientific character. Playthings in the nursery of the classical period may have some similarity to those used by children of the present age. The *Krotalos* is merely our rattle. *Nymphæ*, *Korœ* and *Plangones* are simply the dolls of our girls. There is, too, the *Platagonion*, but this is not a toy. It is a custom, combined with a superstition, which curiously enough is still preserved in modern Greece. The word designates the broad leaf of the poppy, and ancient Greeks used to lay it on the palm of their hands and strike it smartly on the foreheads; it was a good omen if it burst with a loud crack. The *Roptron* is our tambourine—and so on. But we do not possess any toy similar to the extraordinary *psiphoperimombitria*. The actual game for the children was to pronounce the polysyllabic word rather than to play the toy.

The most scientific and fascinating chapter in the book is the lecture the author gave in the year 1921 at the University of Brussels in an elegantly perfect French, which would do credit to any French stylist. He developed in it the theory of *logarithmic spiral*, so strikingly demonstrated in the construction of the shell of the nautilus and other shell-fish as well as in the marvellous spider's cobweb, one of the wonders of Nature, for its unfailing geometrical perfection and unsurpassed delicacy of its thread. It is of the surmised logarithmic spiral that Pythagoras was thinking when he proclaimed the axiom: θεὸς αἰεὶ γεωμειρεῖ which Sir D'Arcy renders into French as: "Le bon Dieu fait toujours de la géometrie". But is the magnificent Greek phrase translatable?

The lectures contained in the volume do not deal with mechanics in classical times. If not a classical, but a mythological legend, that of Icarus made me always guess dreamily of it. Is the single flight of the handsome youth and his fatal fall a mere poetical phantasy or does it correspond to some reality, from which the legend spurted? Or by what mechanical means exactly the enormous blocks of marble from the Pentelicum were transported to the steep hill of the Acropolis for building there the immortal temples still standing erect, though cruelly injured by time, weather and barbarians? I wonder if there will be ever a definite answer to such queries.

Specialists or mathematically minded readers will read with pleasure and profit the two chapters: "Plato's Theory of the Planets" and "Excess and Defect: or the little more and the little less". Moreover, the volume itself will find a choice place, for consultation and relaxation, on the appropriate shelf of the library of the lover of classics.

DEMETRIUS CACLAMANOS.

ELECTRICAL ENGINEERING MATHEMATICS

Mathematics Applied to Electrical Engineering By A. G. Warren. (Monographs on Electrical Engineering, Vol. 9.) Pp. xv+384. (London: Chapman and Hall, Ltd., 1939.) 15*s*. net.

AN editorial preface by Mr. H. P. Young, an appreciative foreword by Dr. Alexander Russell, the usual author's preface, four chapters of elementary 'pure' mathematics (complex numbers and calculus), a concise statement of the mathematical relationships of electricity and magnetism in a single comprehensive chapter, and the book may be considered to be about to commence. In Chapters vi and vii we have many diverse 'applications'. But in Chapters viii and ix we have more 'pure' mathematics—more advanced (partial differential) equations and more advanced methods of integration—in fact, with the exception of a few examples in Chapter x, the whole of Chapters viii–xii can be described as pure mathematics. But in Chapters xiii and xiv we have some real practical problems.

Back to pure mathematics—still more advanced—in Chapters xv, xvi and xvii, and finally some special problems for the remaining four chapters; thus, electromagnetic waves in space and along

wires, Fourier's series and harmonic analysis, Heaviside's operational calculus, and conjugate functions.

"A text-book of mathematics with some examples in the field of the electrical (mainly communications) engineer" would perhaps be a more descriptive title. The reviewer is not a mathematician and certainly not qualified to review a mathematics text-book ; but as a communications engineer he can say that in this book he has found all the mathematics that he has ever had to use and much that he has always wanted to be able to use. If there is any criticism to be made, it is that there should be a greater subordination of the mathematics to the physics of the problem. Equations are stated as describing the phenomenon, the mathematical handle is turned, and the solution emerges. But the fundamental problem of the formulation of the mathematical expressions in connexion with the physical problem, which is necessary before the equations can be arrived at, is perhaps not given sufficient attention. This, to the mind of the reviewer, is the real 'application' of mathematics.

The average engineer has a pocket-book of formulæ, and his one problem is to choose the right formula. Is he much worse off than the engineer who has a book of equations—the appropriate one of which he must choose—but who has learned to turn the mathematical handle and get his own solution or formula ? But the engineer who from a study of the physics of his problem can think in such a way that he can write down his own equations and then solve them (or get a mathematical friend to do so) is definitely of a different standing.

The book will find a prominent place on the reviewer's bookshelf, and he will expect to refer to it frequently.

ELEMENTARY GEOMETRY

Elementary Mathematics from an Advanced Standpoint

Geometry. By Felix Klein. Translated from the third German edition by E. R. Hedrick and Prof. C. A. Noble. Pp. ix + 214. (London : Macmillan and Co., Ltd., 1939.) 15*s*. net.

THIS book continues the translation of Klein's "Elementar Mathematik" which Messrs. Hedrick and Noble began with their translation of the volume on arithmetic, algebra, and analysis. The volume under review is that devoted to geometry. It cannot be claimed that the translation is perfect ; some sentences are English only in the sense that English words are used, but in construction they are essentially German, and there are some eccentricities in spelling, for example, "parellelopiped". There are also some slips which may irritate the reader : for example, on p. 180 a footnote reads, "In the *Sixth Memoir on Quantities* [*sic*]; already cited (p. 145)," and it appears that the reference is to Cayley's memoir on quantics which is correctly quoted on p. 134, not p. 145.

But in spite of these imperfections, the translators have done a useful piece of work in making Klein's volume available to teachers of mathematics who are unable to read the original German text. Klein's comprehensive treatment of the classical geometries and his exposition of the relationships between them have done much to clear up the muddle in which geometry was in danger of being lost, and it is very important that as many as possible should have the opportunity of studying the views of such an eminent mathematician on matters which concern every teacher of mathematics. It can be said that the translators have faithfully communicated the point of view and the general spirit of the original text.

It has often been said, of course, that Klein's definition of geometry is old-fashioned, and does not cover all that present-day mathematicians know as geometry. If this is true, one may ask whether Klein's work has not outlived its usefulness, and whether there is any justification for translating it at this date. We think that there can be no doubt about the answer : Klein's work has still great value, and every teacher of mathematics should be acquainted with it.

In what ways do Klein's ideas fall short of modern requirements ? There are two respects in which geometry has outgrown the views expressed in this book. In the first place, there is more than one branch of mathematical science which is now commonly regarded as a geometry, and which cannot be regarded as the theory of invariants of a group of transformations in the sense meant by Klein. This point has been discussed in several places (see, for example, Veblen and Whitehead's Cambridge Mathematical Tract, No. 29, p. 31). But we do not think this in any way puts the book out of date. Klein's whole idea is to show teachers of mathematics the interrelations of the various geometries which their pupils will have to study in schools and during the earlier stages of their university careers, and for this purpose the point

of view of the Erlanger Programm is not merely adequate, but the best. The pupil will want to extend his ideas of geometry at a later stage; but this should be left until he gets into the hands of the geometry specialist.

The other direction in which geometrical thought has developed beyond the limits of the Erlanger Programm is in the conception of the space in which the transformations are effected, even in the case when we do not go beyond projective geometry. Klein begins his survey from the study of ordinary (real) Euclidean geometry, then introduces the "improper elements"—elements at infinity, imaginary points, and so on. So he goes on until he reaches the conception of the geometries under consideration as the invariant theories of groups of transformations in his generalized space, the projective group containing the others as sub-groups. Then, in the last part of the book he considers the foundations of geometry, starting with the propositions of incidence. It is at this point that we feel that Klein would, if he were writing to-day, modify his work most extensively. By using the ideas of continuity, order, etc., he limits the space with which he is concerned until it is, effectively, the projective space in which the co-ordinates are ordinary numbers, complex if we make use of von Staudt's theory of imaginaries. But, how much of what is involved in this is really required? It is known that if a projective space is defined by means of the propositions of incidence and Pappus' theorem, we can introduce co-ordinates which are elements of a uniquely defined algebraic field, and this gives us nearly all that we want. It is true that in elementary geometry it is usually assumed that the field is of characteristic zero and is algebraically closed. The first condition is easily stated in geometrical form; with regard to the second, it would probably be enough in an elementary account to state as an additional defining condition that the field is algebraically closed, giving examples to show what this implies. We believe that Klein, who repeatedly expresses the desirability of connecting geometry with other branches of mathematics, might well have favoured this modern algebraic method of laying the foundations of geometry, and by his genius have provided the best possible exposition of it.

CROP HUSBANDRY

An Outline of British Crop Husbandry

By Dr. H. G. Sanders. Pp. viii + 348 + 6 plates. (Cambridge: At the University Press, 1939.) 15*s.* net.

THIS is a book which all agricultural students will find instructive. It is set out in a form which can be understood by everybody possessing an elementary knowledge of agriculture, and the enumeration of the reasons and advantages of the methods of procedure discussed will help the student to memorize them. The student will also find the bibliography at the end of each chapter extremely useful. The author has not merely given a list of books of reference, but also mentions papers from journals dealing with the subject. Only an author well acquainted with current literature could have covered so large a field.

Practical farmers will think that the book rather smacks of the lecture room, but they will find it interesting in that their attention is directed to the reasons underlying the various operations that they know from experience are advantageous. The chapter dealing with the choice and treatment of seed should be of interest to them, for at present insufficient attention is given to these important points.

Certain chapters of the book are rather unnecessarily long, and contain too many examples of rotations and dates of cultivation; in practice, rotations are usually broken, and dates of cultivations depend to a large extent upon uncontrollable factors. Evidence is also beginning to accumulate which at present tends to show that perhaps time and money is being wasted by over-cultivating the land.

The chapters on manuring and cleaning the ground will be useful to farmers. The general effects of the different kinds of manures are well set out, with an indication of the type of manure most suitable for the different crops. Fortunately, tables giving results of experiments are not included. The principles underlying the various operations on a fallow are explained; if these were more widely known to farmers, we should not see so many green fallows as we do.

The latter part of the book deals largely with matters about which the modern farmer has little to learn, but which are extremely useful to the agricultural student.

On the whole, it is an interesting and useful book, which will be of far more use to the student than the farmer, though all practical men would learn something from it. J. R. M.

Where is the —— Collection?

An Account of the various Natural History Collections which have come under the notice of the Compiler, Dr. Charles Davies Sherborn, between 1880 and 1939. Pp. 150. (Cambridge: At the University Press, 1940.) 3*s*. 6*d*. net.

THE difficulty of discovering the resting place of some important specimen has been encountered by most systematists, and doubtless justifies the "blue-pencilled" word which the author may or may not have hinted at in the title of this little book. Here about 1,700 entries give names of persons the fate of whose collections is briefly indicated.

Clearly it is impossible in the first instance to make such a catalogue complete; even important collections like the "Discovery" collections in the British Museum or the "Scotia" collections in the Royal Scottish Museum or any of the great Antarctic collections, and many others, are not mentioned. But it is misleading when entries are incomplete or inaccurate: "Edinburgh", "Edinburgh Mus.", "Edin. Mus. Sci. and Art", all inadequately indicate the Royal Scottish Museum, and in it are preserved Hugh Miller's collections and not "in his home at Cromarty"; the famous Dufrêsne collection was bought in Paris by the University of Edinburgh in 1819 for £3,000 and such of it as remains, including some type specimens (not "shells" only), is also in the Royal Scottish Museum; the collections of Sir Charles Lyell, rocks, minerals and fossils, are not "at Kinnordy", but in the Department of Geology of the University of Edinburgh. These and similar deficiencies can be put right in time; the chief concern is that Dr. Sherborn's vast knowledge and painstaking labour have created a foundation upon which a complete *Catalogus Thesaurorum* may be erected, and which in the meantime will be invaluable for reference. JAMES RITCHIE.

Physiology in Health and Disease

By Prof. Carl J. Wiggers. Third edition, thoroughly revised. Pp. 1144. (London: Henry Kimpton, 1939.) 42*s*. net.

THE appearance of a third edition of one of the major American text-books of physiology will be welcomed by teachers of physiology. Extensive revision includes the addition of 1,400 new references, and it is as a guide to the recent literature that the book is likely to make its strongest appeal. In sections in which the emphasis on recent developments is most marked, the impression of a collection of stop-press news sometimes disturbs that of a well-digested presentation. In the course of the transfer from the summaries of original papers to the text, condensation has in some instances played havoc with the sense of the matter described, and a rather high measure of verbal carelessness enhances the feeling that the book does not represent quite the unhurried and matured conception of physiology for which we would have hoped from so distinguished an authority.

The illustrations are not very plentiful and many of them are not very telling. Ingenious and elaborate schematic diagrams of physiological processes and their relations abound, and will satisfy the craving for such things of the most enthusiastic examinee. Nevertheless, the book is alive and has quality, and will continue to be valued as one of the larger standard text-books by lecturers and advanced students of physiology who are concerned with those parts of the subject required for an understanding of human disease.

Earth Science

A Physiography. By Gustav L. Fletcher. Based on "New Physiography", by Albert L. Arey, Frank L. Bryant, William W. Clendenin, William T. Morrey. Pp. v+568. (Boston, New York and Chicago: D. C. Heath and Co.; London: George G. Harrap and Co., Ltd., 1938.) 7*s*. 6*d*.

THE text of this book is based upon Arey, Bryant, Clendenin and Morrey's "New Physiography"; but the order of topics has been entirely rearranged and the subject-matter completely rewritten. As an introduction a general account of the past history of the earth is given, followed by a description of the dynamic forces that are changing the face of the earth to-day, and a study of the material composition of the earth. For the sake of familiarity the land is first surveyed, the author then proceeding to describe the earth's relations in space, the seasons, latitude, longitude, the atmosphere and associated phenomena like weather and climate. The book is rounded off with a study of the sea, special emphasis being placed on harbours. An interesting feature is the inclusion of a completion summary at the end of each chapter. This the reader is required to copy and complete; it is intended to counteract the bad practice of reading only the summaries of chapters. Each section is provided with a range of questions involving every important point raised in the text. The diagrams are clear and liberally distributed, the majority of them being illustrative of North American earth formations.

Protozoology

By Prof. Richard Roksabro Kudo. Enlarged and completely rewritten edition of a "Handbook of Protozoology". Pp. xi+689. (London: Baillière, Tindall and Cox, 1939.) 36*s*.

IN this edition the author has largely rewritten his text, and has also expanded the book to include certain subjects which were not touched upon in the earlier edition. The sections on morphology and physiology have been extended, though the latter appears to deal largely with work published before the first edition of this book was issued. Two entirely new chapters are devoted to ecology, and to variation and heredity. Although the soil is mentioned as an environment, no suggestion is given of the richness of its fauna, nor are some of the common soil species attributed to this habitat. In the taxonomic section a large number of species has been added, though it is still possible to find omissions; but perhaps this is to be expected in a work of this size. More than one hundred new illustrations have been included, and an adequate bibliography is supplied to each chapter.

AN AZTEC HERBAL

By Dr. AGNES ARBER

OUR fragmentary knowledge of the early history of botany in Mexico has lately received a remarkable addition in the form of a reproduction of a manuscript herbal of the sixteenth century, written by an Aztec physician, and now edited by Dr. Emily Walcott Emmart[1]. It had long been known that, by the period of the Spanish conquest, gardening and medicinal botany in Mexico had reached a high degree of elaboration[2]. The fact that the language of the Nahuas included several different names for different types of garden, shows that horticulture played a considerable part in their lives. Montezuma possessed gardens for flowers and medicinal herbs, in which, according to the chronicler, Cervantes de Salazar, he "did not allow any vegetables or fruit to be grown, saying that it was not kingly to cultivate plants for utility or profit in his pleasance". He also owned vegetable gardens and orchards, but these he seldom visited, since he held them to be "for slaves or merchants". His contempt for mere utility did not extend, however, to curative herbs. He ordered his physicians to make experiments with the medicinal plants in his gardens, and to use the best-tried remedies for the benefit of the lords of his court.

Montezuma the Elder, in the fifteenth century, restored an ancestral tropical garden at Huaxtepec. It is recorded that he sent to the Lord of Cuetlaxtla for plants with roots of the vanilla orchid, cacao, magnolia, and other exotics, and asked that they should be escorted by native gardeners capable of cultivating them. His directions were followed religiously, and the plants arrived with their roots in earth and wrapped in beautifully woven mantles. The gardeners, before replanting these treasures, fasted for eight days, and made sacrifices of incense and other offerings before the god of flowers. This procedure was a great success: the plants flourished exceedingly, and Montezuma wept with joy at the triumphant result of the experiment. Dr. Zelia Nuttall, in whose work a fuller account of these matters will be found, writes that nothing now remains of this—the first tropical botanic garden of the American continent—except a few immemorial cypresses.

In 1570 a certain Francisco Hernández was sent to Mexico by Philip II to investigate the natural history of New Spain; he was the first European botanist to study the vegetation of the New World. He spent seven years in Mexico, passing much of his time in the garden of Huaxtepec. It was not until the middle of the seventeenth century, however, that his great work upon the plants of Mexico saw the light; but at an earlier date (1615) Francisco Ximenez issued a partial Spanish translation of it, which has the distinction of being the first published book treating of the herbal remedies of the Aztecs. It has now, however, yielded pride of place, as the first record of the subject, to a small Latin manuscript, bound in crimson velvet of the sixteenth century, discovered in 1929 by Prof. Charles U. Clark in the Vatican Library; this work proved to be an Aztec herbal in Latin, with pictures. In the same year an Italian translation of the Vatican manuscript was found in the Royal Library at Windsor. The Vatican copy has been studied in extreme detail by Dr. Emmart, who, with the aid of a number of public and private benefactors, has been able to publish a coloured and copiously annotated facsimile of the herbal. The whole work is on a sumptuous scale, though the price has been kept intentionally to a low level, in order to bring it within the reach of students.

Soon after the Spaniards had conquered Mexico, schools for the Indians were built with funds provided by the treasury of Charles V. In the Convent of San Francisco in Mexico City, native boys were taught reading, writing, music, and other subjects. These pupils were found to be so teachable that a further step was taken in 1536, when the College of Santa Cruz was established at the Convent of Santiago on the outskirts of the same city. Here the students learned Latin, philosophy, logic, arithmetic, and music. Moreover, the Spaniards realized so fully the importance of the indigenous pharmacopœia, that they brought to the College the best known of the Indian physicians, so that they might hand on the knowledge of native herbs. It was one of these teachers, Martinus de la Cruz, who compiled the recently discovered herbal; its translation into Latin was due to Juannes Badianus, an Indian who was "Reader of Latin" in the College. The manuscript is modestly described on the fly-leaf as "A little book of Indian medicinal herbs, composed by a certain Indian, physician of the College of Santa Cruz, who has no theoretical learning, but is thoroughly instructed by experience alone. In the year of Our Lord Saviour 1552". The work was undertaken as a gift for Charles V, at the request of Don Francisco de Mendoza, to whom it was dedicated. Its intention was primarily medical;

the plants are grouped under the diseases which they are reputed to cure.

Pliny's "Natural History" was one of the Latin texts used by the students of the College, and the latinity of Badianus is said to show signs of Pliny's influence. Since, however, the plants are not those of Europe, they are kept under their Aztec names, which are spelt phonetically and not latinized. Apart from its interest for the history of medicine, the most striking feature of the book is the beauty of the illustrations, which approach two hundred in number. Dr. Emmart concludes that they were probably the handiwork of Martinus rather than of Badianus, but they show so much accomplishment that it may perhaps be suggested that they were executed neither by Badianus, the classical lecturer, nor by Martinus, the physician, but by some professional artist whose name has not come down to us. The peculiarly rich colour of these pictures contrasts happily with the warm tint of the paper, the crimson lettering used for the plant names, and the reddish-orange marginal lines, which enclose the pages. Mexico in early days was famous for its brilliant native dyes, and Cortez wrote that paints of good quality could be bought in the market-place of Tlaltelolco.

To those accustomed to European botanical illustrations, the way in which the roots are portrayed is the most unfamiliar feature of the figures in the Badianus herbal. The technique is difficult to describe in words; but it may be said in general that the root system is indicated in a conventional fashion on a patch of background varying in colour and form. Sometimes the Aztec stone- or water-symbol can be detected. Dr. Emmart claims that in the treatment of the roots, "there is an attempt to represent the ecology of the plant pictorially—a direct carrying over of Aztec pictographic representation". A comparison of the roots throughout the herbal offers—at least to the uninitiated—no very obvious confirmation of this view; if such symbolism was intended, it is, except in special cases, curiously variable and obscure. It is perhaps possible that an explanation of a slightly different and more prosaic type may be worth considering. In Mexico "chinampas", sometimes erroneously called "floating gardens", have been used from antiquity and may still be seen to-day (Nuttall). They are raised mud beds, artificially built up in lakes or lagoons, staked off with cane, and bordered by pruned willows, the interlacing roots of which are trained to form a sort of basket-work which holds the banks. A special method is used for the transplantation of young annuals from mud beds in which the seedlings have been set out. The substratum is cut up deftly into solid blocks, and each plant is lifted with a compact mass of soil enclosing its roots. If the Aztec artist who illustrated the Badianus herbal was accustomed to this mode of handling plants, it might seem natural to him to represent roots in association with a block of the substratum. It is noticeable that, when very small plants of a mossy or turf-like habit are depicted, the individual plant with its roots is not isolated, but a whole group is shown, growing on what is apparently a block of soil. Later research may perhaps prove that the colouring and decoration of these blocks and balls of soil had a well-defined symbolic meaning, but, judging merely from appearances, it looks as if the artist had just enjoyed himself in giving free rein to his painter's fancy.

As representations, the illustrations of the Badianus herbal are of very unequal merit: among the best are those of an aroid (Xanthosoma); two species of Datura; a species of Commelina; and two cacti (Opuntia and Cereus). A great many of the pictures are, however, quite unrecognizable, and bring to mind European herbal illustrations in the degraded condition which they reached after a process of copying from manuscript to manuscript which extended over centuries. Indeed, in looking through the Badianus herbal, one cannot but be struck by the fact that both the realistic and the more conventionalized examples show a decided resemblance to Old World herbal drawings of the period before printing. The general style often so closely recalls that of European plant pictures, that it is difficult to believe that the Mexican figures owe nothing to the stream of artistic tradition which can be traced back to Greek botanical illustration dating from before the beginning of the Christian era.

The American scholars concerned with the Badianus herbal take, however, a somewhat different view. Dr. Sigerist, who writes the foreword, says that the manuscript is "a purely Mexican product", and that "as far as we can see, it shows no traces of European influence". Dr. Emmart also takes the view that "whether the authors of the manuscript ever saw and studied an illustrated European herbal, is a question of considerable doubt", and she regards the technical skill of the Aztec illustrator as "indigenous to the soil of Mexico and not obtained by contact with European culture". No one would, of course, wish to deny that these illustrations are, to a great extent, the outcome of a long tradition of Mexican art; we know, for example, that Nezahualcoyotl, the fifteenth-century king of Texcoco in the valley of Mexico, had pictures of tropical plants painted from Nature and copied on to the walls of his palace. Nevertheless, we may be allowed to feel that the native tradition was to some extent overlaid, in the Badianus herbal, by European influences; otherwise we have to postulate a

degree of parallelism exceeding probability, between the highly stylized and sophisticated schools of herbal illustration of the Old and the New Worlds.

It should be remembered that the Indians were highly susceptible to the education offered to them by the Spaniards ; in the year 1541, Gerónimo López wrote that some of the Indian boys "speak Latin as elegantly as Cicero". We are told, also, that in the Convent of San Francisco, those native boys who showed ability in drawing and writing, were given the task of illuminating manuscripts ; here influences from Europe had a direct opportunity of playing upon Aztec art. The staff of the College of Santa Cruz must have consisted of men of broad culture, and they cannot have carried on their work without books. Even though they were sojourning in a country with an unfamiliar flora, it is unlikely that illustrated herbals found no place in their library, considering the importance then attached to these books from a medical point of view. We may at least conclude that the possibility of European influences having had their role in determining the style of the pictures in the Badianus herbal, cannot at present be rejected. It is to be hoped that the later work of American students of the Aztec civilization may reveal more decisive evidence on this point.

The Badianus herbal contains an important body of directions for the treatment of ill-health, not only by pharmaceutical, but sometimes also by surgical methods. Occasionally there are indications of a surprisingly enlightened attitude. For example, both melancholia and fatigue are recognized as conditions for which medical treatment is suitable. The needs of the ancient Aztecs are indeed ours to-day, for we read of certain medicaments intended to relieve the "fatigue of those administering the government and holding public office", and also serving to "drive weariness far away, and, finally, to expel fear, and fortify the heart of man".

[1] The Badianus Manuscript (Codex Barberini, Latin 241), Vatican Library. An Aztec Herbal of 1552. Introduction, translation and annotations by E. W. Emmart. (Johns Hopkins Press, Baltimore, 1940.) 7.50 dollars.

[2] The Gardens of Ancient Mexico. By Z. Nuttall. (Ann. Rep. Smithsonian Inst., 1925 for 1923, pp. 453–64.)

TREATMENT OF HOUSEHOLD REFUSE

By W. CARMICHAEL,
LIGHTING AND CLEANSING DEPARTMENT, EDINBURGH

THE first question asked by a local authority before embarking upon expenditure in connexion with an intensified salvage campaign is : How much salvage should we extract from our refuse ? This is followed by the query as to the value of the expected salvage, and then : What is the position of the markets for the materials so extracted ?

The second question is most easily answered by local rather than national inquiry, but the first question may be partly answered by the experience of other towns, although it is not possible to lay down a hard-and-fast table of quantities per ton of refuse which may be expected throughout the whole of Great Britain. The average percentages of the seasonal analyses of household refuse conducted under the ægis of the Ministry of Health, prior to the War, offer a guide ; but, as the War has had an effect on normal ways of living, it is prudent to expect this effect to become noticeable in the constituents of the household refuse. Accordingly, the pre-War analyses only comprise a stop-gap until local authorities can institute analyses of their own. The results already achieved by many towns may appear very gratifying from a cash or gross tonnage point of view ; but actual analyses of refuse should be carried out in order to be sure that the full salvage value is being realized.

Few towns are achieving the expected percentage of waste paper expected, namely, one ton per 1,000 of the population per month, or, expressed approximately in terms of refuse, 4 per cent of paper of the total tonnage of refuse handled. Despite the curtailment in the output of paper, this percentage of paper at least is, I am certain, available in every town in Great Britain. In making this statement, I am not taking Edinburgh's high figure for waste paper and making it applicable to all. For the week ending June 8, the percentage of waste paper to total household refuse collected in Edinburgh was 10 per cent. For the month of May, the total sales of waste paper collected by Edinburgh Cleansing Department amounted to 682 tons 6 cwt., with a revenue of £2,809 ; this tonnage represented 8·6 per cent of the total household refuse collected during the month. The high percentage of paper to refuse in the week ending June 8 was due to a sudden spell of hot weather which caused a drop in the ash element of the refuse. These figures show that a collection of one ton of waste paper per thousand

of the population per month is quite possible. The annual recovery of waste paper throughout Great Britain at this rate would represent more than half a million tons. This would be fully one hundred per cent increase on the present rate of collection, and, moreover, sufficient to satisfy the needs of the paper- and board-making industry.

There should be no need to emphasize that the collection of waste paper will prove economical to the collecting authority. A glance at Paper Control Order No. 15 will convince. Present prices for waste paper, loose and baled, are :

	Loose	Baled in 4-ton lots
Newspapers	90*s.* per ton	127*s.* 6*d.* per ton
Strawboards ..	65*s.* per ton	105*s.* per ton.
Books and magazines	70*s.* per ton	107*s.* 6*d.* per ton
Mixed paper ..	40*s.* per ton	80*s.* per ton

In Edinburgh, the revenue from paper pays for the wages of all operatives on refuse disposal and paper collection and sorting, and leaves a surplus.

Prior to the War, Edinburgh could expect $1\frac{1}{4}$ per cent of household refuse to comprise rags. When an analysis was taken recently, we were surprised to find that the percentage of rags was equally as high as that of the pre-September period. However, it is too optimistic to look for such a figure to-day and we prefer to base our output on the Ministry of Supply's expectations, namely, 2 cwt. per thousand houses weekly. There are 120,000 households in Edinburgh, and our total of rags for the week ending June 8 was 11 tons, or just under the Ministry of Supply's expectations. Rags output per household may not be considered so constant as that of paper and its fluctuations will depend more upon economic considerations than does paper, the use of which is more temporary and output dependent on control.

Bones are expected by the Ministry of Supply on the basis of 1 cwt. of the population per month, but, obviously, this figure cannot be expected throughout the whole year. Warm weather is accompanied by a smaller consumption of butcher's meat than cold weather and, accordingly, the summer output might be put at $\frac{1}{2}$–$\frac{3}{4}$ cwt. per 1,000 of the population per month. At present, Edinburgh has been responsible for a little more than half the total of all bones collected in Scotland. The success achieved in the collection of this very important item of salvage has been due in no small measure to the adoption by the Edinburgh Education Committee of the scheme to collect bones through the schools. This scheme was put into force in February and bins were supplied to ninety-five schools for the reception of the bones wrapped in paper. The Medical Officer of Health gave the scheme his blessing from the start, which factor anticipated and effectively answered critics of the scheme from a health point of view.

Probably the householders' response to the appeal for salvage will be greatest in the realm of ferrous metals. Here again, however, tonnage will be a passing phase and, after a thorough comb-out of substantial items, authorities will fall back upon the humble tin can for their constant source of scrap.

Edinburgh has the credit of being one of the leading towns in Britain for salvage consistency and, accordingly, its methods of salvage may be of interest to other towns.

From the salvage point of view, the completion of Edinburgh's new disposal plant at Seafield in the month of the outbreak of war, and its commencement on September 21, came at a most fortunate time, as it meant that, thereafter, the total output of Edinburgh's household refuse would be mechanically treated in plants which offered the opportunity for maximum salvage extraction. The Seafield plant has a capacity of 140 tons per day ; Russell Road (opened in March 1938), 240 tons per day ; and Powderhall, 200 tons per day.

The efficiency of Edinburgh's disposal plants in the extraction of salvage can be illustrated by an analysis of the extraction at Russell Road for the week ending June 15 :

TOTAL REFUSE TREATED : 684 TONS 10 CWTS.

Salvage extracted	Tons	Cwt.	Percentage of refuse
Metals	44	5	6·45
Bottles (8,040) ..	3	7	0·49
Rags	10	19	1·60
Paper	45	13	6·67
Bones	—	15	0·12
Cullet	2	11	0·37
Cinders	70	—	10·20
	177	10	25·90

Thus it appears that 25 per cent of household refuse can be sold for re-use. If the experiments presently being carried out on the city's farms to test the fertilizing properties of the 50 per cent of dust now being screened from the refuse are as successful as the initial reports suggest, it may well be that, in the near future, Edinburgh will be re-selling 75 per cent of the total household refuse collected.

During the week referred to above, in addition to 84 tons of waste paper recovered at the disposal plants, 80 tons were collected by the special collection service. This service, which has been operating since before the War of 1914–18, has collected in the aggregate since that time 51,551 tons of waste paper, which have been sold for £93,126. The service has gradually increased from two horse lorries to ten. Each lorry has a specified route each day, and is entirely devoted to the collection of waste paper. Sacks are supplied to all households or business premises which will take them, and they are collected at weekly or fortnightly intervals. Some 20,000 sacks are in circulation.

The instructions given to Edinburgh householders for the preservation of their re-usable waste, so that the City's Cleansing Department may have it in its best condition, are simple. They are asked to put aside paper and rags to avoid contamination by contact with ashes, etc. Bones should be sent to the school bin; or they can be put in the ash bin and they are then extracted from the refuse at the disposal plants. Collecting vehicles removing refuse carry sacks for the removal of paper and rags.

Recently a salvage shop was opened and, in the space of four weeks, it had attracted 100,000 visitors. In the first week, fifty requests a day were received for the special removal of accumulations of salvage; but, in the succeeding weeks, the number of requests went up to 100 per day. Hourly talks on salvage were given by loud-speakers and, in addition, there was a cinema room where a salvage film, running for ten minutes, was shown at half-hourly intervals throughout the day. This exhibition, without a doubt, has done much to make Edinburgh citizens more "salvage-conscious" than hitherto.

A FRENCH EXPEDITION TO THE CAMEROON MOUNTAINS

By RENAUD PAULIAN,
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IN the summer of 1939 the Muséum National d'Histoire Naturelle de Paris, the Comité de la France d'Outre Mer du Centre National de la Recherche Scientifique, and the International Institute of Volcanology, in full accord with the British Museum (Natural History), sent a scientific expedition to the volcanic mountains of the Cameroons. This expedition consisted of B. Gèze, geologist, P. Lepesme, entomologist, A. Villers, assistant taxidermist, and myself, entomologist. We were to study the biological conditions prevailing on the principal mountains of the Cameroonian range, and we visited Mt. Cameroon (4,070 m.), Mt. N'Lonako (1,800 m.), Mt. Manengouba (2,400 m.), and Mt. Bambouto (2,600 m.). From a climatic point of view, it appears that the rainfall decreases regularly from more than 10 m. a year to about 2 m. a year from the first to the last of the above-named mountains. Together with this decrease in rainfall, human settlements and cattle increase in number and importance. As a consequence, Mt. Cameroon bears a belt of rain-forest from about 1,000 m. to about 2,000 m.; this forest belt is still extant on Mt. N'Lonako, while on both Manengouba and Bambouto the belt has been broken to pieces and the prairie of the surrounding highland plains goes right to the summit. This breaking up of the forest must be rather recent, as in the Bambouto prairie we found isolated plants of tree-ferns and Clematis, both inhabiting the surviving forest patches on the same mountains.

The phytological differences in these mountains bring about important zoological differences. On Mt. Cameroon it is possible to distinguish a number of zoological zones. Beginning at 900 m., around Buea, and ending at 1,000–1,200 m., is a transition zone between the pastures and the lower limit of the rain-forest. This zone is inhabited by quite a number of insects and other animals that do not live in the forest, or in the lowlands below 600 m.: Lacertidæ, Trechinæ, Sericinæ, etc. Above this zone, five successive biological strata may be recognized. Two of them are in the rain-forest itself. The first extends from 1,100 m. to 1,500 m., and the second reaches from 1,500 m. up to 2,200 m. The insect and wood-louse faunas are widely different in these two zones. We may recall here that Engler found two phyto-sociological strata in the rain-forest of Mt. Cameroon and his altitudinal data fit our zoological observations well. In fact, the change of zoological aspect is coincident with the disappearance of the tree-ferns.

From 2,200 m., upper limit of the rain-forest on the south-east, up to 2,800 m., the trees have completely disappeared and the irregular lava boulders of this very strong slope (up to 50°) are covered by a short vegetation of Gramineæ, interspersed at the base with Inula and a few ferns, and higher up with a representative of the Campanulaceæ. This slope is very dry and its fauna is practically nil. From 3,000 m. to 3,500 m. the slope is much less steep; this part has even been called 'plateau' and is deeply cleft by gulleys full of shrubs, Clematis, Adenocarpus, etc.; on the upper ridges the tree-heather, Agauria, grows on the lava-flows, and the grass prairie is strewn with small patches of Blearia. Owing to the frequent lava-flows and to the annual prairie-fires

lit by native hunters, the fauna is very poor; oddly enough, Homoptera and Diptera with a high flight-power make up the greatest part of the fauna. Coleoptera are scarce; apart from two species of Pæderus, which appear to follow man everywhere in those parts, we found only a few Carabidæ, Chrysomelidæ, Curculionidæ and Clavicornia. We could discover neither Amphibia nor reptiles.

Above 3,500 m. nothing grows but lichens and mosses, and the fauna, except for a brachypterous crane-fly, is practically nil. Running water is very scarce on Mt. Cameroon, and the aquatic fauna is poor. I could find no plankton at 3,200 m. and, from 1,500 m. upwards, we saw neither dragon-flies nor caddis-flies. This paucity of the aquatic fauna has already been noted for many volcanic lands, for example, by Aubert de la Rüe in the New Hebrides.

On Mt. N'Lonako, the rain forest rises to 1,700 m., the upper range of the mountain being covered by grass prairie. The fauna is much more important than on Mt. Cameroon, both in the forest and above it, and the aquatic fauna is well represented by Gyrinidæ, a number of dragon-fly nymphs and some aquatic Hemiptera.

On Mts. Manengouba and Bambouto, as already stated, the forest is restricted to broken up patches, completely isolated in the grass fields. The terricolous fauna is rich, with a great number of Carabidæ (Agonum, Stenaptinus, Scarites), Scarabæidæ (Distellopalpus, Heliocopris); beating the bush and sweeping grass give an ample collection of Rhynchophora and Malacodermata; the Chrysomelidæ are scarcer than in the lower forest zone on Mt. Cameroon, and the Galerucinæ are particularly rare, but the Halticinæ seem much more numerous. Owing to the breaking up of the forest many grass-field animals extend to much greater altitudes on Mt. Bambouto than on Mt. Cameroon. This is especially true for all the lizards and the toads. The aquatic fauna is quite important on these two mountains, though aquatic Hemiptera are much scarcer than on the lower table-lands of East Cameroon. On both these mountain ranges the earth layer is very thin, and on Mt. Manengouba I found huge quantities of larvæ of a Cetoniine (*Dymusia cyanea*) living under the stones, on the bare rock. Many of these larvæ appear to be drowned by the heavy rains.

From a bio-geographical point of view, it is interesting to recall that many East African species or groups of species have been found on the Cameroon mountains. Such East African affinities are much clearer in the case of the fauna of Mt. Bambouto than they are in that of the fauna of Mt. Cameroon itself. In fact it appears as if the fauna of the upper ranges (above 2,000 m.) of Mt. Cameroon had been completely destroyed by the lava-flows which built the summit of the mountains, probably (B. Gèze, *C.R. Soc. Géol. France*, **15**, 219; 1939) during the Quaternary. The fauna which is to be found there now is derived from the local lowland fauna. The upper ranges of Mt. Cameroon give us a splendid natural field for the study of segregation, species formation and Cuénot's theory "des places vides", the more so as the upper alpine region is separated from the upper limit of the forest by a thousand-metre zone with a very steep slope on which animal life cannot thrive. Unhappily the frequent prairie fires prevent the normal faunal reconstruction. From the fact that the lower slopes of Mt. Cameroon, from 100 m. to 1,800 m., have a fauna with distinct East African affinities, it must be admitted that this part of the mountain is much older, as old in fact as Mts. Bambouto and Manengouba. The East African character of the fauna and flora of Mt. Cameroon, without any reference to Mts. Manengouba and Bambouto, had been pointed out already by the late G. L. Bates for the birds and by Hutchinson and Dalziel for the flowering plants.

OBITUARIES

Prof. Alfred Fowler, C.B.E., F.R.S.

PROF. ALFRED FOWLER, emeritus professor of astrophysics in the Imperial College of Science and Technology, London, and late Yarrow research professor of the Royal Society, died on June 24.

Alfred Fowler was born at Wilsden, Yorks, on March 22, 1868—the seventh consecutive son of Hiram and Eliza Fowler. The family removed to Keighley about 1876, where Alfred attended various local schools. In 1880 he obtained a scholarship for the Trade and Grammar School, Keighley, from which in 1882 he proceeded to the Normal School of Science (later Royal College of Science), South Kensington, through the aid of a Devonshire exhibition. This terminated after one year, but he continued at the College as a 'teacher in training', and in 1885, at the early age of seventeen, obtained a first class associateship in mechanics. He then became assistant to Prof. (afterwards Sir) Norman Lockyer, and received some remuneration as teacher in training, supplemented by small allowances from the Solar Physics Committee. Among his pupils were many who afterwards achieved distinction—notably

Sir Richard Gregory and Mr. H. G. Wells. In June 1888, a new post of demonstrator in astrophysics was created, and Fowler was elected to fill it.

From this time until Lockyer's retirement from the College in 1901, the two men were closely associated in researches in astronomy and spectroscopy, the full significance of which became clear only after the development of atomic theory had given an interpretation of the origin of spectra. It was then seen that the classifications of stellar and laboratory spectra made on empirical grounds at South Kensington, and in the making of which Fowler took a much more active part than was generally realized at the time, provided invaluable information on the physical conditions in the sources of luminosity, and they became the foundation of the extraordinary progress in this branch of science which has been going on for the last twenty-five years and is still one of the most prominent characteristics of both theoretical and experimental research. Spectroscopy at that time found its chief, and indeed almost its only considerable, application in astronomy, and Fowler was active in day and night astronomical observation not only at South Kensington and at Westgate-on-Sea, where Lockyer had established an observatory, but also in eclipse work in various parts of the world. During his association with Lockyer he went to the eclipses of 1893, 1896, 1898 and 1900 in West Africa, Norway, India and Spain, respectively, and later he visited Spain again in 1905, made important visual observations at the partial eclipse of 1912 at South Kensington, and set out for the eclipse of 1914 in Russia, but was forced to return on account of the outbreak of war.

In 1901, when Lockyer retired from College work and a definite separation was made between the College and the Solar Physics Observatory, Fowler was appointed as assistant professor of astrophysics, and owing to reduced astronomical equipment and the rapid development of the great American observatories, he tended more and more to concentrate on laboratory spectroscopy. His astronomical knowledge and interests, however, still exercised an important influence on his work, and with studies of the series spectra of the elements he associated such outstanding discoveries as the identification of the TiO bands in the spectra of red stars, of MgH and other bands in the spectra of sunspots, and of the CO bands in the spectra of comets' tails. His work on the spectra of hydrogen and helium at once became of fundamental importance with the advent of the Bohr theory in 1913, and from that time onwards he was a leader on the experimental side in the collaboration between theory and observation which has led to the present detailed knowledge of the outer structure of atoms. He was elected a fellow of the Royal Society in 1910, appointed professor of astrophysics in the Imperial College in 1915, and in 1923, when the Yarrow research professorships of the Royal Society were established, he was elected, with Prof. G. I. Taylor, as one of the first holders of the title. He continued to work at the Imperial College and to direct spectroscopic research there until his retirement in 1934.

Of the many services which Fowler rendered to science on the side of administration and organization, it is impossible to give an adequate account in a brief space. In addition to services on the Council and committees of the Royal Society and Royal Astronomical Society (of which he was secretary from 1912 until 1918, president from 1919 until 1921, and foreign secretary from 1931 until 1936) he was, among other things, a member of the Board of Visitors to the Royal Observatory, Greenwich, a fellow founder and president from 1935 until 1937 of the Institute of Physics, a member of the Executive Committee of the National Physical Laboratory and of the Advisory Council of the Department of Scientific and Industrial Research, and, after his retirement, a member of the governing body of the Imperial College. With Fowler, these were no mere formal offices, but responsibilities which he discharged with a thoroughness and strong commonsense which were characteristic of everything he did, and perhaps even more valuable than his overt services were those which he gave spontaneously and generously without thought of return or reward. NATURE, in particular, owes much to his labours. His association with Lockyer naturally brought him into close relation with this journal, and he was a constant contributor to "Our Astronomical Column" which for many years was a characteristic feature of NATURE. But perhaps his outstanding work in this category was done in connexion with the formation of the International Astronomical Union. He had already taken a prominent part in the working of the International Union for Co-operation in Solar Research, which came to an end with the War of 1914–18, and on the formation of the International Astronomical Union, originally as an activity of the International Research Council, he was appointed as the first general secretary, and more than any other single man was responsible for establishing the Union and for the form which it afterwards took. He remained as general secretary for six years.

In later years honours came in quick succession. He was in turn awarded the Valz Prize by the Academy of Sciences, Paris, the Gold Medal of the Royal Astronomical Society, a Royal Medal, and honorary degrees of D.Sc. (Bristol), Sc.D. (Cambridge), D.Sc. (Durham), and D.Sc. (Leeds). In 1920 he was elected *Correspondant* of the Academy of Sciences, Paris, in the Section of Astronomy, and in 1926, president of Section A of the British Association. In June 1935, he was elected a fellow of the Imperial College and created C.B.E. for services to science. American astronomers acknowledged his work by the award of the Henry Draper Gold Medal for Astrophysics, and the Bruce Gold Medal of the Astronomical Society of the Pacific, and by electing him in 1938 as a foreign associate of the National Academy of Sciences.

To those who were fortunate enough to know him, however, Fowler will be remembered chiefly for his inspiration as a teacher and his never-failing encouragement and readiness to help in every way possible. His laboratory was the training-ground for many who have since achieved distinction in various

spheres, and there have been numerous acknowledgments of indebtedness to his guidance and sympathy. It was his aim always to develop and never to repress the qualities he discerned in those who came under his charge, whether or not those were qualities in which he himself excelled. He leaves a widow, a daughter and a son, by whom, and by his many friends, he will be greatly missed.

HERBERT DINGLE.

Lieut.-Commander J. R. de la H. Marett

LIEUT.-COMMANDER JOHN RANULPH DE LA HAULE MARETT, R.N., of H.M.S. *Glorious*, presumed killed in action, was, like his father, Dr. R. R. Marett, rector of Exeter College, Oxford, a student of anthropology, though he approached the subject from a somewhat different angle. Like his father, however, he had a bold pioneer spirit, and was not afraid to collect and review the specialized contributions of many others with the view of showing what came of the synthesis, and what problems were raised in the whole effort to understand man, his race, culture, and environment. Like his father again, he held that all specialized contributions, including his own, must be judged in the light of their relation to the whole complex of studies. Many famous pupils of Dr. Marett will recall this constant attention to great problems and main issues, and those who knew his son, including his former teachers, will remember in him the same flair for formulating and planning the line of approach and possible solution. To the father has been given the fullness of time to show the value of his attitude to life. To the son, this longer time has been denied, but to those who knew his work, there has been ample promise of great fulfilment and much valuable and stimulating achievement.

The younger Marett served at sea during most of the War of 1914–18, and afterwards retired from the Navy to take up farming in Jersey, an island beloved by himself and his father. His main interest as a farmer was the care of a famous herd of Jersey cattle, and as editor of *The Island Cow* he contributed articles on animal genetics that attracted a good deal of attention, more particularly in America. It was this interest in genetics that brought him to Oxford, where he studied anthropology, obtaining the diploma with distinction in all subjects. Later, after a considerable amount of work elsewhere, mainly on problems of genetics, he was awarded the B.Sc. degree at Oxford, for a thesis which afterwards developed into a substantial book, entitled "Race, Sex, and Environment, a Study of Mineral Deficiency in Human Evolution" (Hutchinson 1935). Though this essay deals mainly with man, and covers a vast field, it probably grew naturally out of his earlier work on the theory that the Jersey breed of cattle is Nature's successful attempt to cope with calcium deficiency; and the same principle when extended to man suggests various lines of investigation that may well prove to be exceedingly fruitful. While it is easy for specialists in the varied fields from which he has gathered to criticize him, it must be remembered that much of his synthesis and many of his suggestions are those of a pioneer in a great adventure. His attempt to synthesize work on the soil sciences with that on the ductless glands on so large a scale opens a vast unexplored country, a land of great promise.

During the last few years, Marett was conducting an enthnological survey of Ceylon for the Government, and it is to be hoped that his researches, which have resulted in a rich store of material, will some day be published.

Leaving this valuable work on the outbreak of the present War, he once more undertook active service, and now, to the best of our knowledge, has given his life for his country. While there can be no greater gift, his friends and former teachers cannot fail to regret that a life so full of brilliant promise could not have been given, in the happier times to come, to the constructive work which he was so able to do.

T. K. PENNIMAN.

Dr. E. G. C. Poole

EDGAR GIRARD CROKER POOLE was born in Limerick, the son of Major Walter Poole, R.A.M.C., and educated at Rugby and the Queen's College, Oxford, where he was mathematical scholar. He obtained both the Junior Mathematical (1911) and the Senior Mathematical (1920) University scholarships and two first classes in the school of mathematics. He was one of C. H. Thompson's most brilliant pupils. During the War of 1914–18 he served as a lieutenant in the Intelligence Corps in France. In 1920 he was elected fellow of New College and was for a time a University lecturer in mathematics. At the time of his death he was one of the editors of the *Quarterly Journal of Mathematics*.

Poole was the most learned of the Oxford mathematicians. He had a magnificent library and he constantly read very widely in all branches of pure mathematics. He was an excellent linguist also. His published papers were mainly on differential equations, an important work on which was published by the Clarendon Press in 1936. He was a good teacher and a good colleague. He was, however, ultra-sensitive and events unconnected with himself as, for example, the depression of 1931 and the bad news of this year made him utterly miserable. Despite his fine reputation for work both as a researcher and a teacher, he felt in recent months a keen sense of depression and frustration; this produced the ill-health which led to his death in tragic circumstances on June 28.

Oxford has thus lost a fine and most erudite mathematician, and his college a delightful colleague and friend. He was forty-nine years of age.

WE regret to announce the following deaths:

Sir Alfred Bourne, K.C.I.E., F.R.S., formerly professor of biology in the Presidency College, Madras, on July 14, aged eighty.

Dr. W. E. Harper, director of the Dominion Astrophysical Observatory at Victoria, B.C., on June 4, aged sixty-two.

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NEWS AND VIEWS

Organization of French Scientific Services in Britain

DR. ANDRÉ LABARTHE, as already announced, has been appointed by General de Gaulle to take charge of technical armament services and scientific research for the French National Committee. M. Labarthe, who was born in 1902, was a pupil of the late Prof. Gabriel Koenigs, and specialized in experimental mechanics. After a year in the physical research laboratories of the Ministry for Air, he went to the laboratory for physical and experimental mechanics at the Faculty of Sciences, Paris, where he became *assistant* (1931), and then *chargé de conférences* (1934). His thesis for his D.Sc. dealt with photo-electric methods of measuring pressure, the measurement of torsion, and integrating manometers. In addition, he has studied ultra-rapid cinematography, detonation, and internal combustion engines, particularly Diesel engines. M. Labarthe was the head of a delegation sent to Germany in 1934 to study the Diesel engine, and he has also visited England and the United States to inspect scientific and industrial laboratories. In France he has been technical director in the Department of Aeronautics, and recently director of the Station Nationale de Recherches d'Expériences technique and director of the laboratories at Bellevue. He has received the Plumey Prize of the Paris Academy.

On the outbreak of the War, M. Labarthe put his valuable knowledge of armaments in general, and of internal combustion engines in particular, at the disposal of the French Government, and he was recently technical director and adviser to the Ministry of Public Works. Not only did he succeed in leaving France after the general collapse, but also he managed to bring with him to Great Britain a ship carrying a valuable cargo of copper. In addition to his purely scientific publications, M. Labarthe is the author of "La France devant la guerre," a remarkable study of the 'war potential' of the belligerent nations. That book finishes with a quotation from Lacordaire which to-day has new significance: "Tant qu'un peu de sang français subsistera, la Justice aura sur terre un soldat armé".

War-time Livestock Problems: Advisory Committee

A COMMITTEE to consider war-time livestock production problems has been set up by the Minister of Agriculture. The members of the Committee are: The Right Honourable Lord Moyne, Joint Parliamentary Secretary to the Minister of Agriculture; Prof. A. W. Ashby, professor of agricultural economics, University College of Wales, Aberystwyth; Mr. A. I. Eastwood, London wholesale meat trade supervisor of the Ministry of Food; Mr. G. Gibbard, chairman of the Livestock Committee, National Farmers' Union of England and Wales; Mr. W. Graham, president, National Farmers' Union and Chamber of Agriculture for Scotland; Dr. John Hammond, Animal Nutrition Research Institute, University of Cambridge; Mr. J. Mackintosh, National Institute for Research in Dairying, University of Reading; Mr. W. G. R. Paterson, principal, West of Scotland Agricultural College; Mr. T. Peacock, president of the National Farmers' Union of England and Wales; Mr. W. J. Reid, member of the Scottish Agricultural Advisory Council. The Secretary of the Committee is Mr. H. Gardner, of the Ministry of Agriculture and Fisheries.

Registration of Engineers

THE Minister of Labour and National Service has made an order for the compulsory registration of professional engineers. Registration is with the Central Register. It refers to those who are normally engaged in a technical or supervisory capacity in aeronautical, automobile, chemical, civil, structural and municipal, electrical, gas, locomotive or mechanical engineering; and those normally engaged on research work in the engineering sciences at a university or in research and development work in any industry or as a teacher of engineering science. Men whose names are already on the Central Register are not to register again. There are 22,000 names in the engineering categories of the register, of whom about 800 are not in employment, and it is estimated that 30,000 more names will now be added.

The Rise of Turkey

A PAMPHLET "Turkey: the Modern Miracle" by E. W. F. Tomlin, published in "The Thinker's Forum" (London: Watts and Co. 6*d*. net), gives a brief review of the development of Turkey during the nineteenth century and since under Mustapha Kemal. In outlining the reforms introduced under Mustapha Kemal, while pointing out the extent to which Turkey is a totalitarian country with the People's Party as the supreme organization, its constitution is not so autocratic as might be expected. Its activities are not devoted solely to propaganda, and no institution is more democratic than the People's House or Halk Eir. Modern Turkey is impressed throughout with the spirit of youth, and Turkish education is highly practical and surprisingly democratic. The younger generation is encouraged to use its reason. A passage in the official text-book on citizenship used in all the Turkish primary schools runs: "We shall educate our children in a way which makes them capable of using their brains even in unaccustomed circumstances, of taking necessary decisions without waiting for orders from above, of developing a spirit of enterprise and a desire to overcome all difficulties which may block their way". In a tribute to Mustapha Kemal's achievements, Mr. Tomlin points out that he created a new order of society, a society liberated from the bonds of obscurantism, inefficiency and brutalizing superstition, out of material which seemed at the time to be beyond all reclamation.

War, Drunkenness and Suicide

IN a recent paper (*Brit. J. Inebriety*, 38, 28; 1940) based on his experience at H.M. Liverpool Prison which receives male prisoners from a wide area in the north-west of England and North Wales, Dr. Harvie K. Snell discusses the influence of the outbreak of the present War on drunkenness and attempted suicide, the connexion between which has often been stressed. Under the single heading drunkenness he has included not only simple drunkenness but also cases described as drunk and disorderly, drunk in charge of a vehicle and those charged at the same time with begging and common assault. His figures show the somewhat surprising result that there was a definite decline during the first four months of the War as compared with the previous three years in the number of persons admitted to prison for drunkenness or attempted suicide.

These results are in striking contrast with the late Dr. Sullivan's results concerning convictions in women for the same two offences in 1914, which both showed a marked increase after the outbreak of war, but present the same trend as the figures relating to women admitted to the Manchester Prison from an extensive area in the north-west of England and Wales for drunkenness and attempted suicide in the early months of the present War. Dr. Snell attributes the decline in the incidence both of drunkenness and of attempted suicide on the present occasion to economic and social as well as psychological causes, the former including rise in the price of liquor and the condition of the streets in the black-out period, and the latter the lesser degree of emotional strain leading to drunkenness than that which occurred in 1914.

Colonel Kenneth Macleod

COLONEL KENNETH MACLEOD, an eminent military surgeon and hygienist, was born in the Outer Hebrides on July 23, 1840, the son of a Free Church minister. He received his medical training in the University of Edinburgh, where he qualified in 1864. After four years service in the Indian Medical Service, he was appointed secretary to the Inspector-General of Hospitals in 1872 and held this post until 1879. On December 1, 1879, he was made professor of anatomy in the Calcutta Medical College, a post which he held until his retirement in 1892. Macleod did much for the advancement of medicine in India. In 1869 he investigated Indian cattle plague and set about establishing facilities for veterinary research in India, which culminated in the foundation of the Bengal Veterinary College. In addition to his surgical activities, he took an active part in public work. He founded the Calcutta Medical Society, was its first secretary and later its president, and was editor of the *Indian Medical Gazette* during 1871–92. After his return to England on his retirement, he was appointed professor of clinical military medicine at the Army Medical School at Netley, and held this post until 1905. He died on December 17, 1922.

Early Man and Pleistocene Deposits in America

ALTHOUGH it is established by the find in New Mexico of a Folsom projectile point embedded in fossil mammalian vertebræ that early man in America was contemporary with and hunted an extinct form of bison, the absence or ambiguous character of stratigraphical evidence and associations of a majority of finds of early American stone age industries hitherto have made it impossible to determine with certainty either their age or their place in a cultural sequence. The relation of the Folsom point, for example, to the Yuma type, which typologically is simpler or more primitive, remains obscure, though the finds recently reported from the south-western States indicate a possibility of establishing sooner or later a cultural sequence leading up to Folsom man, and this is brought nearer to being realized by the discovery of the so-called Sandia man, whose existence is inferred from artefacts found in the basal layers of a cave of the Sandia Mountains, near Albuquerque, New Mexico. These artefacts would appear to be the earliest relics of human purposive activity as yet discovered on the American continent. Here, during the past three years, numerous relics of an extinct fauna mingled with human artefacts have been found, of which the stratigraphic sequence has been fully established in recent excavations.

Frank C. Hibben, writing in the *Scientific American* of July, gives a brief outline of the sequence of deposits found in the Sandia Cave. It begins with the surface deposits of dust with which were mingled pottery and other relics of the Pueblo age. Beneath this a layer of stalagmite deposited in a pluvial period sealed late Pleistocene deposits, in which debris bone fragments and soil were consolidated into a homogeneous mass by calcium carbonate. In this material were chips of flint, scrapers and points, among them the true Folsom points. Beneath this Folsom layer was a thick deposit of yellow ochreous laminated material, evidently water-borne, deposited in a second pluvial when the cave was not in use. Beneath this, and between it and the floor of the cave, was the accumulation of a dry period showing the earliest evidence of occupancy of the cave—fragments of bone, evidence of fires, and stone implements. The implements include shouldered points, entirely different from the Folsom point, and said to be comparable to European palæolithic types. By a hearth lay a blackened fragment of the jaw of a camel. It would thus appear that the evidence from the Sandia cave not only points to the existence of Folsom man in late Pleistocene times, but also has established on indubitable stratigraphic evidence the appearance of more primitive culture in a considerably earlier period, contemporary with an extinct Pleistocene fauna.

The Canadian Entomological Service

UNDER this title, Dr. Arthur Gibson, Dominion entomologist, Ottawa, has discussed the more important developments in applied entomology in Canada during the past fifty years. His paper is published in the Transactions of the Seventh

International Congress for Entomology, held in Berlin in 1938, pp. 1429–1479. James Fletcher, in 1887, incepted studies on insects injurious to Canadian crops and in that year he became the first Dominion entomologist. Prior to this time he had acted for a few years in an honorary capacity. On Fletcher's death Dr. Gordon Hewitt, of the University of Manchester, succeeded to the post thus vacated : he held office from 1909 until 1920. In the last-named year the death of Hewitt led to the appointment of Mr. (now Dr.) Arthur Gibson as the Dominion entomologist.

The Canadian Entomological Service has steadily developed each year and has attained a commanding position in the Dominion Department of Agriculture at the present day. Both Fletcher and Hewitt contributed much to its growth and their good work has been worthily upheld and extended by Gibson. Field stations and laboratories are maintained at thirty different localities and there are ten plant inspection stations. When, however, it is recollected that the provinces Manitoba, Saskatchewan and Alberta alone, are larger than France, Germany and Italy combined, it will be realized that Canadian entomologists have no lack of problems to contend with. The Dominion Entomological Service now ranks as the most important of its kind in the British Empire.

Vegetative Propagation in Tropical Plantations

THE Imperial Bureau of Horticulture and Plantation Crops, East Malling, has issued Technical Communication 13 on this subject by G. St. Clair Fielden and R. J. Garner. It deals with the vegetative propagation of some fifty-five plantation crops, and follows a previous communication (issued in 1936) dealing with the vegetative propagation of some one hundred fruit varieties grown in the tropics and subtropics. The help of technical experts has been invoked for adequate treatment of such major crops as rubber, coffee, cacao, etc., while the foreign literature has been thoroughly combed for details of propagation of the less familiar, but nevertheless important, crops. One feature of the previous work, which commended it also to workers in temperate regions, is retained and considerably enlarged, namely, the section devoted to methods used in vegetative propagation. The descriptions are supported by simple, clear, line drawings of some seventeen types of graft and seven types of budding commonly used in vegetative propagation. Tropical workers will also be glad of the illustrated detail of the construction of loosely woven potting baskets which have been found so useful a substitute for pots in nursery work in the tropics. For those who wish to study originals, a list of references immediately follows the discussion on the propagation of each particular crop.

Weeding Methods in Teak Plantations

A. L. GRIFFITH, provincial sylviculturist, Madras has recently discussed an investigation into different weeding methods in the formation of teak plantations in areas with a west coast climate (*Indian For. Rec., Sylviculture*, **4**, No. 2 ; Govt. of India Press, New Delhi, 1939). The investigation was carried out on a number of small-scale experiments and four large-scale ones. Five methods of weeding were tried. At the time, the principal method of weeding the young teak was by the expensive way of forking. The experiments carried on since 1932 have demonstrated that the method termed scraping is cheaper and as efficient on light forest soils ; and that other methods, such as the cheap weeding by weed cutting alone, are not worth while. Weed cutting by hand is by no means cheap in England. By the scraping method it is said that plantation costs are being reduced by Rs. 10 per acre and the quality is as good as formerly. The scraping is done in 4 ft. strips (2 ft. on each side of the line of plants). Weed growth was not cut before. The scraping is effected with an ordinary *mammoty* (like a pointed spade with a recurved handle), removing about ½ in. of soil and cutting the weed roots at that depth below the original soil-level. The weeds removed are piled on the 2 ft. unweeded strips between the lines without cutting the weed growth on them. Or the operation may be carried out over the complete area, the weeds being then presumably removed.

Equine Encephalomyelitis in U.S.A.

IN an editorial article in *Public Health Reports* of April 5 the writer remarks that though equine encephalomyelitis may have existed for very many years in the United States, attention has recently been focused on it by the epidemic in Massachusetts in 1938 when human cases of encephalitis also occurred. There was, however, no indication of human contact infection in these cases. In 1939 only 8,000 cases of equine encephalomyelitis were reported in the United States, or only about 4 per cent of the number (184,662) reported in 1938. The incidence was 1·1 per 1,000 animals (horses and mules) in the affected counties and a case fatality of 30 per cent. The highest incidence was reported from counties in the far-western and Pacific States, a north-east–south-west strip of the central States and three Atlantic States, New Jersey, North Carolina and Florida. As in previous years, more than 90 per cent of the cases occurred in the summer or early autumn, This seasonal prevalence favours the current view that the principal means of transmission is by blood-sucking insects, especially mosquitoes. The prophylactic value of vaccination with a vaccine of chick embryo tissue is shown by the fact that the incidence of encephalomyelitis in vaccinated horses and mules was 0·37 per 1,000 in the vaccinated as compared with 1·2 in the unvaccinated. Other factors in the reduction of the disease were the retarding of insect breeding and increased resistance owing to previous attacks among the animals.

Vehicle Radio-Telephone Service

IT is reported from Pittsburgh, Pa., that the Bell Telephone Co. has applied for a permit to install transmitters and receivers on what is called a 'tie-up' with existing telephone facilities. The company has applied to the Federal Communications Commission

in Washington for permission to place transmitting and receiving equipment on the top of its Pittsburgh building and at certain suburban situations. With this service available, any private or commercial telephone subscriber could converse with the occupants of a properly equipped motor-vehicle moving on the street or highway within a radius of fifteen miles. Each truck or motor-car equipped for the service would have its own telephone number, and would be reached through a special operator, who would handle these calls. It is to be known as the 'vehicular radio-telephone service' (*Elect. Rev.*, June 7).

The Bell Telephone Company's present plans include making the service available to public utility company vehicles and equipment, up to seven of its own vehicles. This would permit quick mobilization and centralized direction of motor vehicles in the event of major emergencies. There are at present limitations on the number of channels available. Otherwise, even at high cost, there would be an appreciable public demand for such telephone installations in privately owned cars. The limitation of the channels will restrict the spread of the service, but in the case of many hospital and police ambulances it should prove very useful.

Rising Cost of Generating Electricity

METHODS are being discussed by electrical engineers to meet the rising costs of generating electricity. Even before the War this was becoming a serious problem. In some cases it had rendered the raising of tariffs inevitable. It apparently was the only alternative to bankruptcy, and the War has certainly not improved the situation. The Electricity Commissioners not long ago published a list of these changes. According to the *Electrical Times* of July 11, Sir Percival Bower, chairman of the Birmingham Electricity Department, made a speech on July 2 in which he stated that his committee is anxious to avoid any increase in tariffs, notwithstanding the formidable increase in costs all round. A fairly large surplus on the last year's accounts is being carried forward to cover any emergency expenditure. Another way of coping with the rise in costs is proposed by Mr. F. H. Whysall of Belfast. If, he says, the department is to pay its way and have a reasonable balance for renewals and reserve accounts, it is impossible to maintain the present low level of charges to the consumer. He intends to recover these increased costs by an equitable method, taking into account the rise in prices of coal, stores and wages. The large consumer is easily assessed, he already has a coal clause in his agreement and he will now feel the effect of other rises in commodities or wages on a similar sliding scale. The principle cannot be applied so precisely to the ordinary consumer, but it happens that an approximation is fairly represented by charging him a round figure of 10 per cent extra for the present, prior to the inclusion of a similar kind of coal clause in his bill. As for the slot-meter house-holder, he will lose his five per cent cash discount.

Development of Rural Electrification in England

SINCE the War began, there is evidence that the sales in Britain of electric milling and dairy equipment have been increasing. In addition, many rural supply authorities find that inquiries as to costs and running expenses of various types of electric motors and pumps are being made on an increasing scale. On the other hand, the extensions to isolated farms will be both more difficult and more costly owing to the rise in the price of materials. In the *Beama* journal of May, it is pointed out that if the War continues for two or three years, it will be necessary for the Government to see that these extensions are carried out in the interests of the better utilization of farm labour. But a question of greater importance is the connexion of farms which are not making a full use of supply mains quite close to them. Just before the War, the most encouraging feature of rural electrification was the willingness of landlords to bear the capital cost of connecting up electric supply, the tenants paying the interest charges. There is also scope for the County War Agricultural Committees to facilitate the group interconnexion of farms. The sanction of the Ministry of Agriculture would have to be sought before these committees could act in this way. The Ministry would probably be sympathetic. Concern is being felt about the problem of threshing on isolated farms, which either possess no tractor or should be making the full use of the farm tractor when it may be desirable to thresh as well. Amongst problems which cripple development of electric power are the high rates customary in times of emergency, and also the cost of the necessary way-leaves negotiations which sometimes, for an isolated farm, cost as much as ten per cent of the total cost of giving supply to the farm.

Agricultural Literature

THE expansion of the Rothamsted Library since the first edition of a catalogue in 1926 has made a new edition necessary (Rothamsted Experimental Station, Harpenden. Library Catalogue of Printed Books and Pamphlets on Agriculture Published between 1471 and 1840. Second Edition 1940. Pp. 293+1 plate. 12*s*. Paper Covers; 15*s*. Cloth Covers). It has been compiled by the librarian, Miss Aslin, who has not merely listed a number of books, but has also added interesting notes on them and their authors. This edition contains two new sections, one including manuscripts and farm account books, the other listing the collection of prints of farm animals which the library possesses.

The catalogue only covers the period 1471–1840, as the books published since the latter date are too numerous to be included in one volume. The period selected is well chosen, for the dates marking its limits are milestones in the history of agriculture. In 1471 the first printed book on agriculture appeared, namely, the Augsburg edition of Petrus Crescentius' "Epistola in librorum comodorum ruralium", and in 1840 Liebig's "Organic Chemistry in its Application to Agriculture and Physiology" was published, thus definitely marking the end of the purely empirical

period of agriculture and the beginning of the application of scientific principles. The catalogue is excellently arranged for the use of students: an alphabetical list of English authors and translations is followed by a similar list of foreign authors and translations, and these latter are also catalogued under the headings of their respective countries. This publication is invaluable not only for students of agricultural history and bibliography, but also for students of horticultural history, since there are numerous references to the early herbals and to treatises on gardening, particularly on the cultivation and propagation of fruit trees.

Springtime the Safest Time

UNDER this title the March issue of the *Statistical Bulletin*, which in spite of its austere title is remarkable for the sprightly character of its contents, illustrates the fact that life and limb are safer in the spring than at any other time of the year by the statement that, if all the year were April, the annual toll of fatal accidents in the United States would be 12,500 fewer than it has been in recent years. During the period 1934–37, the average number of deaths daily from accidents, particularly burns, falls and motor accidents in the United States was 285, whereas during the same years the daily average for April was 251, as compared with July, the worst month, when the average daily toll was 367. The deaths in March and May averaged only a few more daily than in April. In conclusion, the writer recommends that the spring should be the season not only for cleaning the house and making necessary repairs, but also for clearing out "the junk of the mind—the complacency of fixed daily habits which are fraught with hazards".

Earthquakes Registered at Hong-Kong

DURING January, twenty-two earthquakes were registered at the Royal Observatory, Hong-Kong, the greatest number on any one day being four on January 6. The greatest shock recorded was probably that of January 17 at 1h. 21m. 25s. G.M.T., which exhibited a full complement of phases, and showed maximum amplitudes of 10·4 mm. on the north–south component and 8·7 mm. on the east–west component of the Milne-Shaw seismographs. The difference in arrival time of the primary and secondary waves for this earthquake was 5 min. 17 sec., which, according to Jeffreys' latest tables (*Mon. Not. Roy. Astro. Soc.*, Geophysical Supplement, 1939, June), on the assumption of a normal depth of focus gives an epicentral distance of just over 33° from Hong-Kong.

Recent Earthquakes

THE United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association has determined the epicentres of the earthquakes of June 3 and 5. On the basis of reports from sixteen stations, the provisional epicentre of the earthquake of June 3 was lat. 25° N., long. 110° W., which is in the Gulf of California to the east of the island of San José. On the basis of reports from twenty seismological stations, the epicentre of the earthquake of June 5 was lat. 68° N., long. 138° W. This is in the Richardson range of mountains in the extreme north-west of Canada. Both areas are susceptible to earthquake shocks, having experienced them in the past, and both the earthquakes were comparatively large. The first was registered at Kew on June 3 at 18h. 17m. 43s. G.M.T., and the second on June 5 at 11h. 10m. 59s. G.M.T. The second was the larger, having a maximum ground amplitude of 43 μ at Kew. Further moderately large earthquakes were registered at Kew on June 17, 18, and 22, also on July 1 and 6. Information is awaited from other observatories before details of these shocks can be given.

Leverhulme Research Fellowships for 1940

THE trustees of the Leverhulme research fellowships have made awards tenable for varying periods up to two years, for research in the subjects indicated, to the following, among others: Prof. J. R. Bellerby, formerly Brunner professor of economic science, University of Liverpool, post-War economic reconstruction; Dr. R. M. Davies, lecturer in physics, University College, Aberystwyth, experimental investigations on turbulent flow in an air tunnel (renewal of present fellowship); Dr. A. G. Gaydon, Radiation Gas Research Fellow, Imperial College, London, a spectroscopic study of combustion processes in flames and explosions; Dr. N. A. V. Piercy, reader in aeronautics, University of London, mathematical theory of wing sections; W. H. Warburton, Fircroft College, Bournville, a survey of the North Staffordshire pottery industry.

Announcements

MR. J. C. CROCKER has been appointed head of the Department of Chemistry, Chelsea Polytechnic, London, following the retirement on August 31 next of Mr. C. Dorée, who has held the post during the last sixteen years. Mr. Crocker has been senior lecturer on the staff of the Department of Chemistry for many years, during which time, in addition to taking his share in the preparation of a large number of students for their first degree in the University, he has done highly successful work in the training and direction of research students of the Polytechnic for the higher degree in chemistry of the University of London.

IT is announced by the Institution of Naval Architects that the Institution's Library has now been completed by the erection of the memorial to the late Sir Archibald Denny. The Library is situated at the offices of the Institution at 10 Upper Belgrave Street, London, S.W.1.

DR. FRED C. KOCH, professor of physiological chemistry at the University of Chicago and chairman of the Department of Biochemistry, has been appointed Frank P. Hixon distinguished service professor of chemistry in succession to Dr. Anton J. Carison, who will retire at the end of this year.

LETTERS TO THE EDITORS

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

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

Classification of Sub-human Types

DURING the last fifteen years scarcely a year has passed but a new skull has been discovered of a type of primitive man or of a higher ape allied to man's ancestors. We are thus getting a large series of forms which have to be classified, and we are having much new light on the origin of man. Perhaps within a hundred years we may have all the main links between man and an anthropoid such as Dryopithecus, with dozens of forms in side branches, which have left no descendants. But a difficulty will arise in nomenclature.

If we have a line of forms from, say, a primitive Eocene horse like Eohippus to an Oligocene horse like Mesohippus with every connecting link, are we to regard all as belonging to Mesohippus ?

Among the early human types a similar problem is arising. Zuckerman says, "At the present time there does not seem to be any more reason than there was ten years ago for separating generically from one another in classification such archaic types as Sinanthropus, Pithecanthropus, Neanderthal and Rhodesian man"[1]. If these four types are placed in the same genus, that genus will have to be Homo. Zuckerman further suggests that there is "no reason to regard Java man (Pithecanthropus) and Pekin man (Sinanthropus) as generically distinct. This view was reaffirmed last year by Le Gros Clark and has just been restated by von Koenigswald and Weidenreich".

Montandon, on the other hand, considers that Pithecanthropus stands outside the Hominidæ, while he regards Sinanthropus as a more advanced type which is definitely within the Hominid group. While such a difference of opinion exists it would surely be unwise to have the Pekin man called *Homo pekinensis* and placed in the Hominidæ, while an allied species of the same genus is called *Homo erectus* and placed in a different family.

It may be some years before we are in a position to state definitely the affinities of such types as Pithecanthropus and Sinanthropus, and even to be at all sure whether Sinanthropus is closely related to either Neanderthal man or Rhodesian man, and it seems to me nothing will be gained at present by putting all these four types in the genus Homo.

Further, to place Pithecanthropus in the genus Homo commits us to a definite conclusion which may or may not be correct ; and, while the majority of anatomists at present agree in regarding Pithecanthropus as a primitive type of man, there are, and have always been, many who regard it as distinctly subhuman. Even should it prove to be the ancestor of man, I cannot see any reason why it should not be left as Pithecanthropus, while there are very definite objections to placing it in the genus Homo. Pithecanthropus with a brain of 800–950 c.c., an enlarged canine tooth in the male and a diastema in front of it, may belong to the same genus as Dean Swift with a brain of 2,100 c.c., but at present many, and even Dubois himself, still have doubts.

R. BROOM.
Transvaal Museum,
Pretoria.
June 8.

[1] NATURE, **143**, 511 (1940).

Radioactivity of Be^{10}

WHEN beryllium is bombarded with deuterons, a group of protons is observed, with a range of about 26 cm., which is attributed to the reaction Be^{9} (H^{2}, H^{1}) Be^{10}. It has been assumed that the product of this reaction is the species which McMillan[1] found in a beryllium target after prolonged bombardment. Recently, Pollard[2] has reported that the activity in question decays with a period of 350 years. This figure was obtained from the number of protons emitted (which indicates the number of beryllium nuclei formed) and the number of electrons from the decaying substance. Further, the latter author found that the maximum electron energy was about 0·75 Mv.

This high electron energy in combination with the long life at once leads to the necessity that the transition involved is at least doubly forbidden, as one can verify by inspection of the Sargent diagram. If this is so, it leads to the conclusion that the ground states for Be^{10} and B^{10} are not both S states as suggested by Feenberg-Wigner and Hund[3], unless a γ-ray follows the transition. In order to obtain further information about the radioactivity of Be^{10}, I tried to produce it by another method which would allow of its concentration in a small amount of matter. For this purpose boron was irradiated with slow or fast neutrons, which leads either to Li^{7} and an α-particle, or to Be^{10} and a proton.

To make the method as sensitive as possible, about 700 gm. boric acid were placed around a lithium target which was bombarded with 900 kv. deuterons. The Be^{10} was separated chemically after 10 mgm. beryllium had been added as carrier. The beryllium oxide was tested inside a counter so designed that even very soft particles could be detected. Since the neutron source emitted, at the voltage used, and for a current of 100 μ amp., $1{\cdot}8 \times 10^{10}$ neutrons per second, and the total dose was 700 μ amp.-hours, the total number of neutrons passing through the substance was $4{\cdot}4 \times 10^{14}$. As one electron per second could certainly have been detected, an upper limit for the cross-section of this reaction can be found if Pollard's value for the decay constant is accepted. σ becomes, as calculated from the above figures and the geometry, about $\leq 2 \times 10^{-28}$ cm.^{2} ; this representing a mean value for the inhomogeneous neutron beam.

This value is far smaller than could reasonably be expected, as the reaction is slightly exothermic and should take place with considerable ease with fast neutrons. This result must mean either that the reaction is for some reason extraordinarily improbable, or that the activity observed by Pollard and McMillan is in fact not Be^{10}, since the decay constant determined by Pollard can scarcely be in error by several powers of 10. Support for this last suggestion lies in the circumstance that the activity from a beryllium target has not been identified chemically by the previous observers.

I am greatly obliged to Dr. N. Feather for the loan of his counter and to Mr. W. Birtwhistle for technical assistance.

Note added on proof: R. D. O. Neal and M. Goldhaber (*Phys. Rev.*, **57**, 1086) have shown that the observed activity of Be on deuteron bombardment is due to H^3.

E. BRETSCHER.

Cavendish High Tension Laboratory,
Cambridge.
June 29.

[1] *Phys. Rev.*, **49**, 875 (1936).
[2] *Phys. Rev.* **57**, 241 (1940).
[3] See summary Jordan, P., *Ergeb. exakt. Naturw.*, **16**, 90.

Cosmic Ray Intensities in Relation to Cyclones and Anticyclones

IN a previous letter[1], we showed that cosmic ray intensities undergo characteristic changes during the passage of cyclones. The computations were carried out for cyclones irrespective of any seasons. Since, however, the paths of cyclones are generally subjected to seasonal variations, it is possible that the seasonal effect of cosmic ray intensities is superimposed on the results there obtained. We therefore followed the procedure as mentioned below, which enables one to eliminate the seasonal effect. The results thus obtained corroborate the previous conclusions. The same method was also applied to anticyclones.

We used nearly the same hourly means of cosmic ray intensities, 362 in number, observed during the traversal of the same 11 typical cyclones as were chosen in the previous letter, the only minor difference being the rejection of two unimportant cases which were disturbed by magnetic storms. The same method of representation on a polar diagram was also followed as before. Instead of writing down, however, the values of cosmic ray intensities themselves on the sections of the diagram corresponding to the positions of Tokyo, we put down their percentage deviations from the mean intensities during the passage of individual cyclones. In this way we obtained the mean percentage deviation for each section as given in Fig. 1, which shows the variation of cosmic ray intensities due to cyclonic migration free from the seasonal effect. As can be seen from the figure, the general features are nearly the same as in Fig. 2 of the previous note, although the magnitude of the variation is less, namely, $\pm 0{\cdot}5$ per cent in this case.

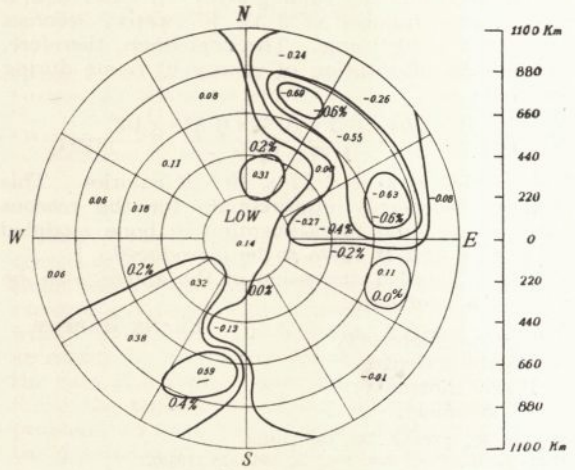

Fig. 1.

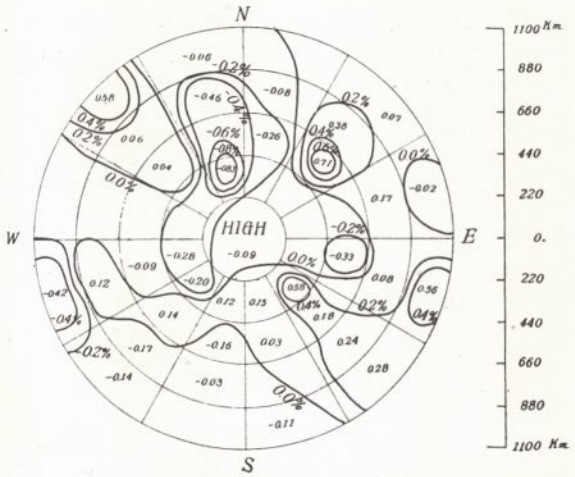

Fig. 2.

Exactly the same procedure was adopted for 25 cases of anticyclones, the centres of which were determinable within a radius of about 1,100 km. from Tokyo as before. Corresponding hourly means of cosmic ray intensities, 598 in number, were treated in the same way as above. The final results thus obtained are given in Fig. 2, in which the distribution of intensity deviations is more complicated than that of Fig. 1. Since the anticyclone traverses the area in question from west-north-west to east-south-east, carrying cold air masses of polar origin in the front and warm air masses of tropical origin in the rear, the general feature of Fig. 2 seems again to illustrate the fact that the arrival of a cold air mass tends to increase the intensity of the hard component of cosmic rays, while that of a warm air mass tends to decrease it, in conformity with the instability of the meson. The high values, however, in the north-west quadrant as well as in the south-west quadrant, as shown in Fig. 2, seem to show that the warm rear of the anticyclone is again followed by a cold air mass. Whether this is due to the cold front of the succeeding anticyclone or to the specific character of the anticyclone itself will be seen in the future.

This work was done as a part of the programme of the Cosmic-Ray Sub-Committee of the Japan Society for the Promotion of Scientific Research.

Y. NISHINA.
Y. SEKIDO.
H. SIMAMURA.

Institute of Physical and Chemical Research,
Tokyo.
H. ARAKAWA.

Central Meteorological Observatory,
Tokyo. April 22.

[1] Nishina, Y., Arakawa, H., Sekido, Y., and Simamura, H., NATURE, **145**, 703 (1940).

Crystal Structure of Rochelle Salt

WE have succeeded in finding approximate positions for all the atoms of Rochelle salt (sodium potassium tartrate tetrahydrate) in the crystal structure. The unit cell has dimensions 11·93 A. × 14·30 A. × 6·17 A. ($Z = 4$), and the space group is $P2_12_12$. The set of general positions expressing this symmetry is

$$xyz\,;\ \bar{x}\bar{y}z\,;\ \tfrac{1}{2}+x,\ \tfrac{1}{2}-y,\ \bar{z}\,;\ \tfrac{1}{2}-x,\ \tfrac{1}{2}+y,\ \bar{z},$$

and the co-ordinates of the various atoms are as follows (expressed in sixtieths of the cell edges):

2K	on (0 0 3)	4O	on (15 24 51)
2K	(0 30 9)	4O	(3½ 21½ 49)
4Na	(15 0 30)	4OH	(9½ 21½ 19)
4C	(9 11½ 18)	4OH	(15 14 38)
4C	(7 16½ 27)	4H_2O	(27 18 1)
4C	(9½ 16 39)	4H_2O	(23½ 4½ 30)
4C	(9½ 21 49)	4H_2O	(15 3 51)
4O	(7 6 20)	4H_2O	(25 24 26)
4O	(13½ 11 8)		

We are not satisfied with the accuracy of these positions; but we have no doubt that our general idea of the structure is correct. It agrees with two-dimensional Fourier syntheses projected down the a and b axes (the signs of the F's being obtained from intensity changes in the differently substituted salts) and also with a three-dimensional Patterson diagram of the ammonium salt, for which all the intensities were observed. All the interatomic distances are reasonable. The water molecules seem to be either of the three- or the four-bonded type. They co-ordinate the sodium and potassium atoms and assist in bonding these to the tartrate molecule. The tartrate molecule itself has an extended carbon chain with the two identical halves of the molecule lying in two planes inclined at 60° with one another.

It is hoped to derive more accurate positions and to publish a fuller account of the structure very soon.

C. A. BEEVERS.
W. HUGHES.

Dewar Crystallographic Laboratory,
University of Edinburgh.
June 25.

Calculation of Energy Absorbed in Irradiated Tissue

IN a previous letter[1], a method was outlined for the volume integration of dosage for X- and gamma-ray beams of radiation. The result of the calculations for a beam of X-rays passing through a 'water phantom' from a 200 kv. Metropolitan-Vickers X-ray tube filtered through 1 mm. copper and 1 mm. aluminium at a focal skin distance of 40 cm. showed the integrated dosage R, to be

$$R = 5{\cdot}6 \times Ar_0 + \frac{Ar_0}{0{\cdot}085}\left(1-e^{-0{\cdot}085(x-5{\cdot}6)}\right), \quad (1)$$

where A is the area of the applicator at the skin surface and r the maximum skin dose for a large applicator (20 cm. × 15 cm.).

When applied clinically, the above formula allows of comparison of energy absorbed by patients during treatment; but for the computation of absolute energy further calculations are necessary. A method of deducing these absolute values using the ionization method of measurement in small air chambers in the irradiated material has been devised by Gray[2], who states that . . . "If secondary beta radiation is being generated in a medium M at a rate E_v ergs/c.c./sec. then the rate of production of ions in a gaseous medium enclosed in a small cavity in M is $J_v = E_v/W\rho$ . . . . (2), where W is the average energy lost by a beta particle per pair of ions produced and ρ is the ratio of the stopping power of M and the gaseous medium for the particles concerned". Since R is the total integrated dosage in a volume V, then $\int_0^V J_v dv = R/t.e$, where e is the charge in E.S.U. on an electron, and t the time in seconds to liberate the charge. The energy absorbed from an X-ray beam passing through a homogeneous medium is therefore

$$E = \frac{R \times W \times \rho}{e} \quad . \quad . \quad (3).$$

The validity of this equation, however, depends on certain definite conditions[2]. On applying these to the present problem, it is seen to be essential that the material of the absorbing phantom and the dosimeter walls have the same value of ρ, and that the ratio of loss of energy of a beta particle producing an ion pair in air and in the medium be known. The results[3] used in the calculation of integrated dosage were obtained by means of dosimeters the walls of which had approximately the same mean atomic number and electronic density as the water of the phantom; but these walls had been rendered conducting with a film of graphite. Thus the assumption that ρ is the same for dosimeter walls and water is not correct, but for clinical work where homogeneity is non-existent, and the electronic density of tissue only approximates to that of water, the results may be regarded as sufficiently accurate.

The ratio of the number of electrons per c.c. in air at N.T.P. and in water is $0{\cdot}858 \times 10^3$; then the quantity of charge T liberated in tissue as compared with air is given by

$$T = R \times 0{\cdot}858 \times 10^3 \text{ E.S.U.}$$

The energy liberated in tissue is $E = \dfrac{R \times W \times 0{\cdot}858 \times 10^3}{4{\cdot}77 \times 10^{-10}}$;

where W, the mean energy required to produce an ion pair in air, is 32·5 eV. or $5{\cdot}2 \times 10^{-11}$ ergs. (Since this letter was written, it has been shown by Lasnitzki and Lea[4] that the relative ionization in tissue for equal ionization in air for gamma and hard X-rays is 1·12; thus the energy absorbed in tissue from the beam considered above is probably 12 per cent greater than the value given.) In water with a mean atomic number of 3·33, W (water) becomes $1{\cdot}04 \times 5{\cdot}2 \times 10^{-11}$ ergs. The expression, therefore, for the total absorption of energy in tissue during irradiation is

$$E = \frac{R \times 1{\cdot}04 \times 5{\cdot}2 \times 10^{-11} \times 0{\cdot}858 \times 10^3}{4{\cdot}77 \times 10^{-10}} \text{ergs};$$

or $E = 97R$ ergs or $2{\cdot}32 \times 10^{-6}$ R calories. This value is necessarily approximate for the reasons stated above, and for absorption in bone modified values of ρ and W have to be introduced.

A more detailed discussion of the above is to be given at a later date.

FRANK HAPPEY.

Physics Laboratory,
Radium Centre,
Royal Infirmary,
Sheffield.

[1] Happey, F., NATURE, **145**, 668 (1940).
[2] Gray, L. H., *Proc. Roy. Soc.*, A, **156**, 578 (1936).
[3] Parker and Honeyburne, *Brit. J. Rad.*, **8**, 684 (1935).
[4] Lasnitzky and Lea, *Brit. J. Rad.*, **13**, 149 (1940).

The Evolution of the Stars

Drs. Hoyle and Lyttleton have raised[1] some objections to the results of the application of nuclear physics to the problems of stellar evolution as discussed in my recent articles on this subject[2].

The main difference between the two points of view consists apparently in the fact that, whereas I maintain that the stellar mass remains essentially constant during the evolution, Hoyle and Lyttleton are of the opinion that the stellar energy, although manifestly due to nuclear reactions, actually comes from the cosmical material collected by stars on their way through space. It is easy to see, however, that the rates of accretion as calculated by Hoyle and Lyttleton[3] are too high by a factor of many thousands, because they have not taken into account the thermal motion of the particles of the interstellar gas. This has led them to a formula according to which the amount of matter collected by a moving star is inversely proportional to the cube of its velocity. It is known, however, that, due to the interaction with the light quanta of interstellar radiation[4], these particles must possess thermal velocities as high as 15 km. per sec. (for hydrogen). These high velocities reduce quite considerably the effective cross-section for capture, and the hydrogen collected can scarcely secure more than one twenty-thousandth part of the radiation of typical giants.

Also, I cannot agree with Hoyle and Lyttleton that "the basis of nuclear theory is in need of revision" in order to make possible the building-up processes in the stellar interior. Our present knowledge concerning the possible nuclear reactions is too well established (both experimentally and theoretically) to make any such revision possible. Thus, Weizsäcker's[5] view that the elements are older than the stars remains the only way out.

The remark of Hoyle and Lyttleton that in my articles "no attempt is made to account for the three distinct periodicity groups of pulsating stars" is apparently due to the fact that they have overlooked the whole discussion pertaining to Fig. 2. In fact, the existence (disputed at present) of these three groups represents the best argument in favour of my views.

Finally, I quite agree with Messrs. Hoyle and Lyttleton that the problem of complex stellar groups (binaries and clusters) is still awaiting resolution.

G. GAMOW.

George Washington University.
March 1.

[1] Hoyle, F., and Lyttleton, R. A., NATURE, **44**, 1019 (1939).
[2] Gamow, G., NATURE, **144**, 575, 620 (1939).
[3] Hoyle, F., and Lyttleton, R. A., *Proc. Camb. Phil. Soc.*, (4), **35** (1939).
[4] Dunham, T., *Proc. Amer. Phil. Soc.*, **8**, 277 (1939).
[5] v. Weizsäcker, C., *Phys. Z.*, **39**, 633 (1938).

PROF. GAMOW appears to agree with our view that accretion of hydrogen by the stars from the cosmical cloud would be important if the rate were sufficiently rapid to compensate the transmutation of hydrogen within the stars. He believes, however, that the accretion rate is too low for this to be happening in the case of a typical giant by a factor of order 10^4. Since the publication of our initial paper[1] on this problem, we have been able to proceed further with the discussion of the physical aspects of the process, and we have been able to show that in reality the difficulty mentioned by Prof. Gamow does not arise.

The accretion rate is proportional to ρ, the density of the cosmical cloud, and in our earlier papers we took an averaged value for ρ. But in certain regions of the galaxy, for example near the galactic plane, the density is probably much higher than the average for the galaxy as a whole. In addition, it has appeared from recent observational work[2] that the average value of about 2×10^{-23} gm. per c.c. at first taken by us may be too small by a factor of about 4. Combining these effects, we have shown[3] that the density probably exceeds 10^{-21} gm. per c.c. in exceptional regions of the galaxy, and the massive stars are regarded as being confined to these regions, thereby giving a natural explanation of such dynamical features as the marked concentration of massive stars towards the galactic plane. In this way a factor of 10^2 is accounted for from the discrepancy urged by Prof. Gamow.

The remaining factor has arisen on account of the assumption by Prof. Gamow that the cosmical cloud everywhere possesses high thermal energy. It now appears from recent work[3] that in regions of density 10^{-21} gm. per c.c., the presence of even a small proportion of hydrogen molecules (of order 10 per cent, say) will prevent any appreciable temperature being maintained by the cloud. The reason for this is that the translatory energy of motion of the particles of the cloud must be in equilibrium with the internal energy of the molecules, since the thermal and internal energy tend to reach equipartition as a result of collisions within the cloud. Thus the effect of collisions is to excite the vibrational and rotational levels of the $^3\Sigma$ state of the molecules, and this internal energy can be radiated by quadrupole transitions to the ground state of the molecules. In a cloud of density 10^{-21} gm. per c.c., the time between successive exciting collisions of a particular molecule is of order 10^7 sec., whereas the lifetime for a quadrupole transition of the excited molecule is only about 10^2 sec. Consequently the molecules radiate away the energy supplied by selective absorption, and it can readily be shown that the cloud will take up a temperature of approximately $6\sqrt{Tx/y}$, where T is the temperature of the source of radiation illuminating the cloud, x is the proportion of material in ionized form and y is the proportion in molecular form.

For the purpose of applying this result to the accretion process, it is only necessary to show that an appreciable proportion of the cloud is in molecular form at a distance from the star of the order of the capture radius, since it must then follow that the material near the capture radius cannot rise to high temperature either by selective absorption or as a result of collisions caused by the gravitational field of the star. This question is of particular interest in relation to stars of high surface temperature, since these stars emit a relatively large quantity of radiation capable of disrupting the molecules. Consideration of this problem has shown that for such stars a molecule may persist at distances equal to the capture radius, as given by us for these stars[1], provided the density of material through which the star is passing is sufficiently high. A value 10^{-21} gm. per c.c. for the density can be shown to be adequate for the main body of the *O* and *B* stars. In a cloud of this density the life-time against disruption by the action of stellar radiation is of order 10^{13} years. For a cloud of density 10^{-23} gm. per c.c. the life-time of the molecules is much shorter, and in large tracts of the galaxy it may well be the case that molecules are easily dissociated and constitute only a very small

fraction of the material in these regions. In this case the temperature of the cloud may be expected to rise to 10,000°, in accordance with Eddington's well-known results.

Accordingly, the reference by Prof. Gamow to the observations of Dunham does not necessarily provide evidence of the temperature in the regions of high hydrogen density, since the interstellar calcium and sodium may be as abundant in regions of low hydrogen density as in regions of high hydrogen density, and the interstellar lines of these elements could then be broadened as a result of high thermal temperature in the regions of low hydrogen density.

R. A. LYTTLETON.
F. HOYLE.

St. John's College,
Cambridge.
May 16.

[1] Hoyle and Lyttleton, *Proc. Camb. Phil. Soc.*, **35**, 405, 592 (1939).
[2] Camm, *Mon. Not. Roy. Astro. Soc.*, **100**, 45 (1939).
[3] In course of publication.

Rust-Resistant Wheats for India

ALL the three rusts of wheat occur in India. It has been shown that in the plains of India the severe summer heat kills the rust spores and that the wheat crop is infected anew each season by spores blown down from the hills, where wheat is cultivated up to an altitude of about 9,000 ft. above sea-level. The barberry, though common in the hills, seems to play little part in the annual recurrence of black rust[1], and it is the self-sown wheat plants and ratoon tillers from harvested plants in the hilly areas which constitute the most obvious means of carry-over of rusts from year to year.

Since 1935, we have been endeavouring to breed rust-resistant wheats suitable for cultivation in the hilly regions of India, the project being financed by the Imperial Council of Agricultural Research. The greatest obstacle in the way of breeding a rust-resistant wheat has been the total lack of *vulgare* varieties highly resistant to the physiological races of black rust occurring in India. Although the number of physiological races is very small (up to date only six races of black rust, six of brown and nine of yellow have been found in this country), no *vulgare* variety resistant to the most virulent and widespread race 15 or race 40 of black rust was available.

The only wheat then known to possess considerable resistance to these races was the *dicoccum* variety, Khapli. Unfortunately crosses between this and *vulgare* varieties either failed or gave rise to sterile plants only. In only one cross (Reliance × Khapli) did an F_1 plant set grains, and even in this case only two grains were obtained. These two grains gave rise to plants of the Khapli type, and subsequent progenies behaved similarly. In view of this difficulty, a thorough search was instituted for *vulgare* varieties resistant to black rust, and each year a large number of indigenous and imported varieties were tested. We are glad to announce that our search has been successful and that in a batch of *vulgare* varieties, most of them bred at Njoro, kindly supplied by the Director of Agriculture, Kenya, a promising degree of resistance has been found. One of them, *E.* 144, has proved to be highly resistant to races 15 and 40.

It will be seen that in *E.* 144 we have a wheat which should greatly simplify the plant breeder's problem in India so far as black rust is concerned. *E.* 144 has also shown marked resistance to a mixture of all the six races of black rust in the adult stage. *E.* 148 is highly resistant to all the races of yellow rust in the seedling stage.

The varieties are late and under Indian conditions poor in yield and, therefore, unsuitable for direct cultivation. They are, however, invaluable for breeding, and we have already made crosses between these and some of the Indian varieties.

A number of Kenya wheats received through the kindness of Dr. H. Wenholz of New South Wales are also under test. These wheats appear to be different from the foregoing, but also include forms which possess high resistance to rust.

K. C. MEHTA.

Department of Botany,
Agra College, Agra.

B. P. PAL.

Section of Economic Botany,
Imperial Agricultural Research Institute,
New Delhi.
May 13.

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Plasma Alkali Reserve in the Domestic Fowl

EXPERIMENTS have been made in this laboratory with the view of tracing the possible influence of egg production on plasma alkali reserve in the domestic fowl. White Wyandotte pullets were fed on a ration supplemented with 5 per cent calcium carbonate, and others on the same ration without this supplement. The plasma alkali reserve (determined by the Van Slyke–Cullen technique) of the birds on the low calcium ration fell slightly at the start, and then remained at a level between 58 and 66 vol. carbon dioxide per cent; the onset of laying did not have any noticeable effect on plasma alkali reserve.

In the case of the pullets on the high calcium ration the plasma alkali reserve rose during the pre-laying period to a level as high as 88 – 89 vol. carbon dioxide per cent. The values remained high during the laying period, but there were indications that heavy laying may affect the level.

These results were clearly due to female reproductive activity, for the plasma alkali reserve of a cock did not vary outside the limits of 62–69 vol. carbon dioxide per cent whichever ration was fed.

Data for the blood composition of laying and non-laying fowl published by Heller and Pursell[1] also suggest a displacement of blood acid-base equilibrium towards the alkaline side in association with laying: in every instance the blood chloride index calculated from their data is lower in the case of laying birds. These observations are of interest in relation to the changes which egg-laying may bring about in the composition of the fowl's skeleton[2] and to Tyler's[3] recent work on the mineral metabolism of bone in the laying fowl.

Pullets receiving rations adequate in calcium carbonate not infrequently display an unexpectedly high Ca/P retention ratio during the pre-laying period[4,5], suggesting that pre-laying storage of calcium can be in forms with a Ca/P ratio higher than that of the skeleton as a whole. Tyler[3] has recently shown that subsequent drafts on skeletal calcium for shell formation fall preferentially on a bone mineral fraction of very high Ca/P ratio, or may withdraw calcium from the skeleton without withdrawal of phosphorus.

It is suggested that, when the calcium carbonate intake is sufficient, laying is preceded by an adjustment of the blood acid-base equilibrium in association with calcium storage, so that the newly deposited bone mineral may have a higher Ca/P ratio than the skeleton as a whole ; this material would presumably be readily available for shell formation. Morgulis[6] has remarked that the carbonate content of bone (and hence its Ca/P ratio) may be related to blood alkali reserve.

The mineral metabolism of birds laying on low calcium rations requires special consideration and may differ from that of birds receiving adequate calcium supplements. It may be significant that serum phosphatase attains very high levels under such conditions[7].

It is hoped to publish a fuller account of these experiments at a future date.

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Co-existence of Oxidizing and Protective Mechanisms for Vitamin C in Plant Tissues

VITAMIN C occurs exclusively in the reduced state in fresh vegetables. Although enzymes and copper, which oxidize the vitamin, are widely distributed in plants, the vitamin is not oxidized. It would appear, therefore, that there must be some mechanism in plants which prevents the oxidation of the vitamin. Although the existence of such protective mechanism has been established in animal tissues[1], it has not been shown to be of such wide occurrence in plants.

During the course of researches on the nature of ascorbic acid oxidase of vegetables, an interesting observation was made on the existence of a protective mechanism in plants, which protects vitamin C against oxidation. It appears that both the enzyme 'ascorbic acid oxidase' and the protective factor occur together in certain vegetables, and the two factors have been separated from one another.

The procedure adopted in obtaining these two factors separately was to add an equal volume of acetone to the expressed juice obtained from the vegetable, and the precipitate which contained the enzyme was centrifuged and dispersed in water. The acetone extract after centrifugation was evaporated on a water bath in order to drive off the acetone completely and the aqueous extract thus obtained contained the protective factor, which protects vitamin C from oxidation, both in presence and absence of added copper. The course of oxidation was followed manometrically by measuring the oxygen uptake in Warburg respirometers, and by titration with the indophenol dye. These two factors are found to exist together in a number of vegetables investigated, and they can be separated by adopting the above procedure. Some of the typical plants which are found to contain these two factors are *Cucumis sativus*, *Cucurbita maxima* and *Luffa acutangula*.

So far there appears to be no indication in the literature regarding the co-existence of both the factors—the oxidizing and the protective factors—in plants. It is probable that the effect of the enzyme ascorbic acid oxidase present in plants outweighs the action of the protective constituents, so that the influence of the latter on vitamin C is not apparent, when both of them occur together. Hence it would appear that the failure of previous workers to observe any significant amount of protective substances in plants is to be ascribed to the occurrence of ascorbic acid oxidase in association with the protective substances, and without separating the enzyme from the protective constituents, the detection of the latter would not be possible.

Further work on the isolation, purification and the nature of the protective constituents is in progress. Full details of the work will be published elsewhere.

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Potassium and Carbohydrate Metabolism

Pulver and Verzár[1] have recently reported that the up-take of glucose by the yeast cell is accompanied by a simultaneous up-take of potassium, and that the latter is liberated again in the course of fermentation. It appears to me that this result has some bearing on the interpretation of certain other findings concerning the relation of potassium to carbohydrate metabolism.

It has been found that the anaerobic fermentation of glucose by baker's yeast increased, on an average, by about 150 per cent if potassium (0·01 *M* potassium chloride) was added to the medium, which contained as other cations hydrogen, ammonium and magnesium[2]. An increase occurred also if an equivalent amount of sodium was added, but it was much smaller. Other investigations have shown that the anaerobic fermentation of glucose by tumour tissue was markedly greater in a medium containing both sodium and potassium (in physiological concentrations) than in a medium containing sodium alone[3,4]. Similar results were obtained with normal tissue, especially brain cortex[4]. Further, it was found that the aerobic fermentation and oxidation of glucose by brain cortex could be increased considerably by the addition of a surplus of potassium to the medium[5,6].

These results have shown that potassium is able to activate the enzymatic breakdown of glucose, but the question was left open how this activation takes place. Pulver and Verzár assume that the inward diffusion of potassium which they have observed is connected with the phosphorylation of glucose as the initial reaction leading to the formation of a polysaccharide which afterwards breaks down. This assumption is supported by the result that substances which retard phosphorylation inhibit the up-take of both glucose and potassium. From this point of view there appear to be at present two main possibilities regarding the explanation of the effect of potassium upon fermentation and oxidation of glucose. Either potassium activates phosphorylation,

and thereby the subsequent formation of the supposed polysaccharide, or it activates the breakdown of the latter. In the former case potassium might be bound chemically, while in the latter case it might be adsorbed by the polysaccharide (having probably colloidal properties). In both cases potassium would be liberated again as soon as this compound breaks down.

It must remain for the future to ascertain which of these two possibilities agrees with experimental facts, and to find out the detailed mechanism of the potassium effect for yeast cells as well as animal cells.

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Advantages of Uranium Fixation in Modern Cytological Technique

AN attempt to use uranium as a fixing agent was apparently made as early as 1882 when Schenk[1] noticed that uranium acetate had a mild fixing action and a high degree of penetration. The nitrate and acetate have since been used for special purposes by Cajal[2], Nebel[3] and others. Uranic acid as a substitute for osmic acid was introduced in this laboratory some years ago. Catcheside[4], who kindly carried out a number of tests with this reagent, finally came to the conclusion that, although good fixation could be obtained, the effects were rather erratic, and La Cour[5] later confirmed the views expressed by Catcheside. Semmens[6] first gave a systematic account of the value of uranium as a substitute for osmium in fixatives employed for plant cytology; he also indicated the theoretical grounds for the use of this metal. In a later paper[7] he further pointed out that the erratic fixation previously recorded appeared to be due to the variable composition of the so-called uranic acid of commerce. To overcome this difficulty he proposed the use of sodium diuranate ($Na_2U_2O_7$), a compound that is much easier to standardize.

There has been a marked tendency in recent years towards the use of more simple mixtures than those previously employed for fixing purposes. It may be as well to point out here that simple fixatives will leave the situation much less obscure for those who wish to attempt a biochemical interpretation of cytological results. Extensive trials with numerous types of plant material in this laboratory have led to the decision that Levitsky's[8] chrom-formalin, used for root-tips, gives fixation every bit as good as anything obtained with the more complicated mixtures which include osmic acid. Chrom-formalin, however, does not give such good results with pollen mother cells or with pollen grain divisions, for which the Flemming type of fixative is as a rule more satisfactory. It is a matter of common experience that osmic acid, owing to its high cost, cannot be used for smear preparations made on an extensive scale. For pollen grain divisions and for meiotic material it has been found that sodium diuranate can be very advantageously used in place of osmium tetroxide. 1 per cent chromic acid in which is dissolved 2 per cent of uranium diuranate is now considered to be the most effective mixture and has been used in this laboratory with excellent results.

In the development of the rapid smear methods[9] involving the use of Feulgen light green technique[10], we have tried various combinations of fixing fluids, and as a result of such trials have found that the chrom-uranate mixture not only gives uniform and satisfactory fixation of pollen grains and pollen mother cells but also considerably improves the nucleolar staining, possibly due to the additional mordanting action of the sodium component. It has also been found that this mixture, followed by Newton's gentian violet technique with subsequent chromic mordanting, gives far better preparations which are also more permanent than those obtained by the ordinary method. We therefore strongly recommend the use of sodium diuranate in place of osmium tetroxide in fixing fluids for material that is to be stained by either the Feulgen light green or the gentian violet techniques.

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Books and Periodicals for Interned Scientific Men

THE Government's policy with regard to aliens has resulted in the internment of a very large proportion of the refugee scientists who were in Great Britain. It should be remembered, as has been recently pointed out by the Prime Minister, that though there may be enemies of the country among them, by far the majority are genuine victims of Fascism and amongst its bitterest opponents. Many refugees have made valuable contributions to science whilst in Great Britain, and some of them were actually engaged in work of national importance at the time of their detention.

We are not able to judge the wisdom or value of this indiscriminating internment, but there is one way by which we can lighten the misfortunes of our fellow scientists and mitigate any feeling of bitterness which might arise. This is by supplying them with the books and periodicals which will enable them to keep abreast of new developments in science and play their part efficiently in the reconstruction of the post-War world.

Those in internment camps are only allowed to receive new books and publications direct from the publishing offices, and individuals could arrange for books to be bought and sent to scientists in the camps. Newly published books and periodicals can also be sent to the camp libraries, and learned societies might consider sending copies of their journals to these libraries through the Y.M.C.A.

Such action would be a valuable demonstration of that international spirit of science on which all true scientists set so much store for the future of humanity.

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RESEARCH ITEMS

Prehistoric Village Site, Ontario

THE Lawson prehistoric village site, Middlesex County, Ontario, Canada, had already suffered severely from amateur collectors when it was explored by W. J. Wintemberg during 1921–23, but with the addition of scientifically valuable evidence from private collections it has been possible to reconstruct a picture of the material culture of the inhabitants (*Bull.* **94**, Anthrop. Series, 25, Nat. Mus. Canada; 1940). The territory in which the fort is situated is known to have been inhabited by the Neutral Indians of Iroquoian linguistic stock. Probably it had been inhabited long before traders penetrated the region. The site is surrounded by slopes steep on north and south sides, elsewhere less steep. The village probably lay at the east end. Along the north side flows the Medway, a navigable stream, and on the south, Snake Creek, and there is a spring on the west end of the site. Refuse deposits and pits, in groups, of unknown purpose have been found; and there are eleven fireplaces, some round, others oval. The site is strategically important. The east and west ends alone were vulnerable and had to be protected by earthworks. Post-holes for palisades were found along the north and south sides of the site, in places in four rows. The houses were probably like the bark-covered cabins of the Hurons, 2–40 fathoms long and about 4 fathoms wide, and of the same height. Post-holes of small, nearly round habitations, 8–9 ft. in diameter, were found. In the evidence of foodstuffs, animal remains were more numerous than plant remains, but probably both were used in about equal amounts. About 11,000 animal bones were found, including those of mammals, birds, turtles and amphibians, as well as shells of land and freshwater molluscs. About one hundred fish bones were secured. Certain artefacts, animal bones and vegetable products indicate hunting, fishing and agriculture as modes of subsistence. About 14,000 potsherds were found, none, however, permitting reconstruction. Tools consisted of axes, adzes and chisels of stone, antler and teeth, whetstones, rubbers, scrapers, flaking tools, points and hammerstones.

Rock Engravings on the Indus

A SERIES of rock-engravings or chippings were observed in 1931 and succeeding years by Cuthbert King in Attock, the most northerly district of the Punjab Province, India (*Man*, May, 1940). The engravings are on groups of large stones lying on the right (North-West Frontier Province) bank of the Indus about three miles below the Attock bridge near the village of Darwaza. At times of flood and generally during the summer months the rocks are wholly or partially submerged. The stones are of black basalt, and the pictures or marks are pecked on a smooth surface, but not artificially prepared. Local tradition is that the three engraved rocks figured were originally one, which was split by lightning. They certainly show signs of violent fracture, while the technique and subject-matter of the engraving on all three appear uniform in every way. Afterwards, further examples were discovered up-stream, while similar engravings were recorded on rocks near the Haro River about a mile above its junction with the Indus, 1½ miles below the first discovery, and also in the Indus itself above this confluence, but showing slight differences from the Darwaza engravings. Some of the markings show resemblance to Chinese characters, while others resemble stylized figures of Swedish and Spanish rock-engravings. Sir John Marshall, to whom the find was reported, considered them to be of the late historic period, while their similarity to many rock-drawings of the medieval period has been pointed out.

Precautions against American Foul Brood in Bees

CERTAIN aspects in the treatment of American foul brood among bees are discussed in the *Bee World* of June. As in any disease of bees, it is necessary to prevent the bees from carrying infection into a clean hive and also to realize that all infected hives and apparatus require adequate sterilization. If either of these measures be neglected or inadequately carried out, all effort is wasted. Ignorance of the means of infection by a given disease is a potent source of trouble. Thus, until the discovery that *Bacillus pluton* is carried on the mouth-parts of the adult bees, the failure of the most careful measures for controlling American foul brood remained unexplained. In connexion with disinfecting hives, nearly all competent advisors recommend scorching by means of a painter's blow-lamp. This method has its disadvantages, since it is difficult to burn out the corners and crannies without undue burning of the wood. The application of hot washing soda and water is much easier and cheaper to use, but the question arises as to whether it will kill the spores of the disease organism. Apparently a reliable answer to this question is not available and full inquiry is badly needed.

Indian Palæobotany

INDIA has long been known to be very rich in fossil plants, and it is fortunate that there should now be an able Indian palæobotanist with a vigorous school of fellow workers. In a reprinted lecture by B. Sahni ("Recent Advances in Indian Palæobotany", Lucknow University Studies; 1938–39) we have an excellent survey of a field wide enough to include such matters as mountain uplift and continental drift, and in addition a most encouraging promise of fresh results from many pieces of work now in progress. Two of these pieces of work have now appeared ("Jurassic Plants from Afghan Turkistan", by R. V. Sitholey, *Mem. Geol. Surv. Ind.* (*Pal. Indica*), **29**, Mem. 1; 1940: "The Fossil Charophyta of the Deccan Inter-trappeans near Rajahmundry (India)", by K. S. Rao and S. R. N. Rao, *ibid.*, Mem. 2); that on the Charophyta provides welcome evidence for the Lower Tertiary rather than Cretaceous age of a very important formation, while Sitholey's work is of value in providing new localities for certain Middle Jurassic

species, and though his flora is small, it will be a useful item of information in building up the complicated story of the history of this vast area.

Preservation of Vegetables by Waxing

IT has long been known that a thin film of natural or artificial wax on the surface of plant tissue is effective in reducing its rate of water loss, and commercial processes have been developed, particularly in the citrus industry, which take advantage of this fact, more than 75 per cent of the oranges grown in California and Florida now being treated in this way. The possibility of extending the process to include vegetables which have to be stored for some time before sale is now being investigated and useful results are described by H. Platenius (Cornell Univ. Agric. Exp. Station, N. York, *Bull.* 723). The method which appears to be the most promising is the dipping process, which can be carried out by hand or mechanical equipment. The vegetables are first washed, and without drying are dipped momentarily into a cold wax emulsion at room temperature and then dried thoroughly, the average thickness of the resulting dry film varying from one to two microns. The chemical nature of these emulsions is very complex. Essentially they consist of colloidal suspensions of one or several kinds of waxes in water, the minute particles being kept in the disperse phase by means of a soap. One of the waxes used contained bentonite in addition to paraffin and a soap. Proprietary articles were used in these experiments, and their names, together with those of their manufacturers and partial compositions, are given. A large variety of vegetables were tested. The results obtained with topped carrots and cucumbers were outstandingly good, and in general the process can be recommended for all root crops with the exception of parsnip. The waxing of leafy vegetables is not advised, nor for those which are shipped with ice on top of the container. Waxing does not improve the quality of an inferior product, nor does it prevent the progress of disease; but it does reduce shrinking and maintain the fruit or vegetable in a fresh condition for a longer period than would be possible without treatment.

Rust Fungi of the Genus Prospodium

THE very numerous species of rust fungi form a rather unwieldy taxonomic unit, and it becomes a matter of necessity to sub-divide the Uredinales into convenient sub-groups. One of these, the genus Prospodium, proposed by J. C. Arthur in 1907, has recently been studied in detail by George B. Cummins (*Lloydia*, 3, No. 1, 1–78; The Lloyd Library and Museum, Cincinnati, Ohio, U.S.A., March 1940). Prospodium is separated from the other Uredinales by the picturesque character of possession of appendages to the spore pedicels. This ornate feature is, however, linked to a more fundamental criterion in the limitation of the host range favoured by the genus to Verbenaceæ and Bignoniaceæ. The present discussion attains monographic proportions, with accounts of structure, life-history, taxonomy, a key to the fifty species with a detailed description of each, and the necessary bibliography.

Pleiotropic Effect of Genes

WHETHER genes in general affect only one or a few characters of the organism or whether all genes of an organism affect most characters is an important question in genetics. J. J. Schwab (*Genetics*, 25, 157–178; 1940) has analysed the effect on the shape of the spermatheca of *Drosophila melanogaster* of eleven single mutant strains chosen for convenience of observation. These stocks were continuously backcrossed to an isogenic wild strain and the spermatheca were measured before, during and after the period of backcrossing. Statistical analysis of forty controlled generations, of which twenty were designed to permit crossing-over, was made. It was found that out of eleven segments studied, nine were able to affect the shape of the spermatheca, a character also selected for experimental convenience. Hence "structures may be affected by a multiplicity of genes".

A Fungicidal Fertilizer

S. C. TENG makes the interesting suggestion in *Sinensia* (8, Nos. 5–6; September 1937) that urine be employed as a fungicide, and shows that it is effective against the sclerotinia disease of asparagus lettuce and other maladies. Ammonia is evidently the fungicidal compound, and the liquid is applied during transplantation, at the rate of one litre per square foot of soil. Urine is a common fertilizer in China, and its use as a fungicide in no way diminishes that property.

Constituents of the Higher Fungi

ERGOSTEROL has been isolated from some higher fungi, but so far as was known no well-characterized members of the terpene group, such as the triterpene resinols, had been isolated from fungi. L. C. Cross, C. G. Eliot, I. M. Heilbron and E. R. H. Jones (*J. Chem. Soc.*, 632; 1940) have now examined the birch tree fungus, *Polyporus betulinus* Fr., and after saponification of the extracts have isolated three polyporenic acids, all of which are probably triterpenoid. Two of these (*A* and *B*) appear to be isomeric $C_{30}H_{48}O_4$ acids, and both contain two hydroxyl groups and two ethylenic linkages. The third (*C*) may be identical with gypsogenin, $C_{30}H_{46}O_4$, isolated from Gypsophila and other species of Saponaria.

Earthquakes in the Aleutian Islands

THE United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the epicentres of the earthquakes of April 16 and May 4, 1940. The shock of April 16 happened at 6h. 7·7m. G.C.T., and, using reports from twenty-six seismograph stations, the epicentre was calculated to be near lat. 52·6° N., long. 173·8° E., which is just to the north-east of Near Island at the extreme western end of the Aleutian Islands. The shock of May 4 occurred at 7h. 24·1m. G.C.T., and from instrumental reports obtained from Weston, Honolulu, Hong Kong, Manila, Sitka, State College (Pa.), Chicago, Fordham College (Alaska) and Burlington the epicentre turned out to be very close to the previous one, namely, lat. 53·0° N., long. 173·0° E., or immediately north of the Island of Attu at the extreme western end of the Aleutian Islands group. Increased seismic activity in the Aleutian Islands has been noticeable during recent months.

Structure of Sulphur Dioxide

THE structure of the sulphur dioxide molecule has been re-investigated by the electron diffraction method by V. Schomaker and D. P. Stevenson (*J. Amer.*

Chem. Soc., **62**, 1270; 1940), who have obtained improved diffraction photographs and find the following results. The S—O distance is $1{\cdot}43 \pm 0{\cdot}01$ A. and the bond angle O—S—O $120 \pm 5°$. The entropy determination of Giauque and Stephenson (*ibid.*, **60**, 1389; 1938) gave for the product of the three principal moments of inertia of the SO_2 molecule the value $(10{\cdot}58 \pm 0{\cdot}99) \times 10^{-116}$ gm.cm.^{2}, and this value with the above bond distance gives 121° as the bond angle, in excellent agreement with the electron diffraction value.

Configurations of Quadricovalent Complexes

As is well known, the configuration of some 4-covalent complex compounds of metals is tetrahedral, and of others it is planar. G. N. Tyson and S. C. Adams (*J. Amer. Chem. Soc.*, **62**, 1228; 1940) have measured the magnetic susceptibilities of salicylaldehyde complexes of copper, nickel and cobalt, and the salicylaldimine complexes of copper and nickel. From the results the following configurations have been assigned to the compounds. Cobaltous and nickelous disalicylaldehyde probably have tetrahedral configurations, nickelous disalicylaldimine is planar, and cupric disalicylaldehyde and cupric disalicylaldimine are probably planar. In the case of the nickelous compounds, the formation of the disalicylaldimine from the disalicylaldehyde involves a change from a tetrahedral to a planar configuration, and this is attended by a marked colour change from green to orange.

Attainment of Very High Pressures

M. JAMES BASSETT has recently described the attainment of pressures of the order 50–75,000 kilograms per sq. cm. (*J. de Phys. et le Radium*, Ser. 8, **1**; April 1940). This has been achieved by the use of a special carbide of tungsten, out of which the component parts have largely been made, though steel forms part of the general framework. A special feature of the apparatus is its maintenance at the temperature of liquid air, thus taking advantage of the increased resistance to compression or tension which all metallic bodies exhibit at low temperatures; special precautions are taken to prevent any access or accumulation of moisture. Three diagrams illustrate the main features of the design, but the scale of operations which could be carried out cannot be stated, as no dimensions are given in the text.

Photographic Action of Metals

THE photographic action of certain metals has been fully recognized since the researches of Russell more than forty years ago. J. A. Reboul returns to this subject (*J. de Phys. et le Radium*, Ser. 8, **1**; 1940). Further experiments have led him to the view that Russell's working hypothesis is inadequate to account for all of the phenomena which have been observed to date. Russell maintained that the action was due to the presence of hydrogen peroxide. This is allowed by Reboul, who, however, maintains that part of the effect is due to a very 'soft' radiation from the metals themselves; he hazards the view that this radiation is itself excited by cosmic radiation. Such a conclusion is tentative in view of the fact that these phenomena have so far not been examined under conditions which, of themselves, reduce the cosmic radiation to insignificant proportions. The protean character of the phenomena remind the reader of the Volta effect.

The *K* Term and the Galactic Rotational Constant

W. M. SMART has criticized the claims of Plaskett and Pearce to have solved the mystery of the *K* term (*Mon. Not. Roy. Astro. Soc.*, **100**, 5; March 1940). Some time ago, Smart offered some criticisms of their work (*Mon. Not. Roy. Astro. Soc.*, **96**, 568) and Plaskett accepted the validity of the criticism; but in spite of this, he still maintains that in actual practice a theoretically incorrect procedure is justified by the results. In their investigations, Plaskett and Pearce made use of 132 *B*-type stars lying between galactic longitudes 210° and 330°, known as the Southern Stream, which they believed formed a moving cluster. Smart has shown (*Mon. Not. Roy. Astro Soc.*, **100**, 60) that these stars do not form a moving cluster but are merely a normal sample of *B* stars, yielding a solar motion of 19 km./sec. and a *K* term of 5·2 km./sec. The value of $K = 8{\cdot}3$, derived from the stars of this so-called Southern Stream, has very little significance. He now shows that in their earlier paper Plaskett and Pearce gave solutions which were derived from an incomplete equation of condition and are therefore erroneous. The conclusion is that the only information relating to the *K* term of moderate accuracy that survives concerns the normality of the *K* term for the distant stars of Groups 1 and 2. It is impossible to say at present what the value of *K* will be for the nearer stars, included in Groups 3 and 4; this can be obtained when solutions are made for these groups with the corrected equation of condition and without any arbitrary adjustment of the radial velocities. The claim of Plaskett and Pearce to have reduced the *K* term to its gravitational value is not admitted.

Masses of the Stars

A MONOGRAPH with this title, by Henry Norris Russell and Charlotte E. Moore, has appeared (Chicago: University of Chicago Press. London: Cambridge University Press. 21*s.* net). It is the outcome of a lecture delivered by Prof. Russell in connexion with the Harvard tercentenary and contains all the direct evidence available regarding the masses of the stars, that is, that derived by gravitational motions from binary systems. The first chapter deals with visual binaries and contains a large amount of statistical discussions. A new empirical formula connecting mass with luminosity is given at the end of the chapter, and though it is impossible to provide a complete theoretical explanation of the formula, nevertheless it is available over a wide range, and should be adequate for the computation of stellar parallaxes. Spectroscopic and visual binaries are dealt with in the second chapter, and in the next chapter there is a collection of various discussions under the headings, statistical theory for slow-moving pairs, triple systems, mass ratios, astrophysical conclusions. A curve shows the close agreement between the empirical linear formula connecting mass and luminosity and observational data, and where large discordances exist these correspond to small or poorly determined groups, or to uncertainty in the individual values, as in the case of the "Trumpler stars". Chapter iv presents a new treatment of the determination of dynamical parallaxes and introduces a number of refinements. Tables are also given which facilitate the computation of parallaxes from double-star data. In the last chapter there is a general catalogue of the dynamical parallaxes of 2,529 stars which have been calculated by the methods explained in the previous chapter.

RELATIONS BETWEEN MOLECULAR AND MORPHOLOGICAL SHAPE OF PROTEIN SOLUTIONS

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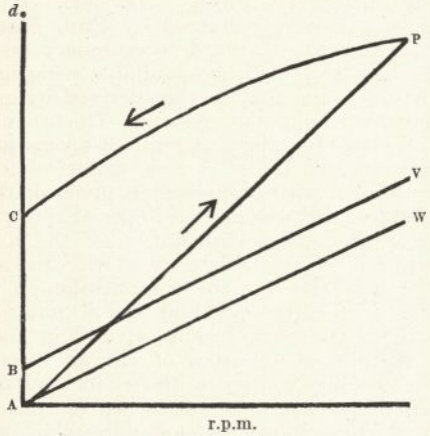
THE experiments on which we wish to make the following preliminary report originated from our belief that further knowledge of the shapes of molecules may throw light on the nature of morphological and histological shapes, and the changes which they undergo. We were especially interested in the formation of the neural tube in the amphibian embryo, where this, the first, morphological change in development consists of a great lengthening of the cuboidal ectodermal cells and nuclei to form the cells of the neural plate. The question arises whether this elongation may not depend upon, or be accompanied by, an increase in the number, size, or axial ratio of anisometric protein particles present. With this in mind, we compared the behaviour of protein fractions isolated from amphibian neurulæ with that of other proteins.

The viscosimeter, designed by one of us (A.S.C.L.), consists of an inner cylinder of stainless steel suspended on a torsion wire, and an outer cylinder of stainless steel which can be evenly rotated at speeds varying from 0·5 to 200 revolutions per min., the whole being contained in a jacket allowing of accurate temperature control. The apparatus allows also of simultaneous measurement of flow birefringence. The annular space contains about 15 c.c. when the inner cylinder is just submerged.



The advantages of the Couette (coaxial cylinder) viscosimeter over those of the Ostwald (capillary) viscosimeter are sufficiently well known. The latter gives results from which calculations are scarcely possible since there is no constant rate of shear. Nor is it suitable for studying changes in a solution subjected to known shear forces for varying periods of time. It should also be noted that the study of anomalous flow at low rates of shear is a measure of approximation to complete randomness and hence not interfered with by the simultaneous presence of globular particles, while the study of flow birefringence is interfered with to a much greater extent since it is a measure of approximation to complete orientation in the stream lines.

The results may most conveniently be summarized by reference to the accompanying diagram, which reduces the facts to their simplest form. In the accompanying figure the deflection of the mirror on the torsion wire is plotted against the shear force applied to the solution by the rotation of the outer cylinder. The inner cylinder is not completely submerged. The line *AW* represents that given by water. The line *AP* represents that given by proteins of Class 1. The flow here is normal, and the relative viscosity is therefore constant whatever the shear force. It is to be assumed that proteins of this kind have globular molecules or aggregates. Proteins of Class II, however, give lines such as that shown by *BV*, the reading being abnormally high at low rates of shear and falling off at high rates. Such *anomalous flow* means that the relative viscosity varies with the rate of shear, falling from a very high value to a constant level when perfect orientation of the long particles in the stream lines is attained. On denaturation with guanidine hydrochloride or traces of copper, anomalous flow is completely abolished.

A third class of proteins exhibit more complex behaviour. At first they follow a line similar to that of Class I (*AP*), but when slow speeds are again applied an *anomalous return* is obtained, cutting the abscissa at a much higher level (*PC*). If now this solution is removed from the apparatus, diluted, and put back, anomalous flow, similar to that shown by *BV*, is obtained. It has not as yet been possible to find positive proof that this phenomenon is due to the spinning off of anisometric protein particles from the surface film, but such an explanation appears at present to be the most likely one. That the anomalous return itself is due to the formation of a protein polylayer at the surface on rotation, however, is certain. The formation of such a built-up film, the time-relations of which can be followed in detail, never manifests itself if the inner cylinder is totally submerged, since the torque on the suspension wire is negligible in comparison with that on the cylinder itself.

We have not so far found any protein which showed anomalous flow initially followed by anomalous return.

We are inclined to believe that the initial behaviour of protein solutions of Classes I and III when the inner cylinder is not completely submerged is probably due to a liquid surface monolayer rather than the bulk of the solution, for if the inner cylinder is entirely covered, the concentration of protein needed to obtain equivalent relative viscosities is very greatly increased (for example, from 0·001 to 0·1 per cent). This is not the case, however, in all probability, with proteins of Class II.

We have provisionally placed the proteins studied by us in the following classification :

Class I. Crystalline methæmoglobin (prep. Dr. Danielli).
Crystalline insulin (commercial for physiological use).

Class III. Crystalline ovo-albumen (prep. Dr. Danielli; many times recrystallized).
Myosin (prep. Dr. Bate-Smith. Preparations made in Cambridge, unlike those of Edsall *et al.*[1], show little or no flow birefringence, but appear in all other ways undenatured).
Pseudoglobulin from amphibian neurulæ.
Aged tobacco-mosaic virus nucleoprotein (which showed less than one-tenth of its original intensity of flow birefringence).

Class II. Tobacco-mosaic virus nucleoprotein (prep. Dr. Pirie. Here our results are in complete confirmation of those of Robinson[2]).
Total globulin fraction from amphibian neurulæ.
"Myosin" fraction from amphibian neurulæ.

To the above we should like only to add that we have noted remarkable continuous decreases in relative viscosity of certain protein solutions even when standing at 0° C., notably the amphibian embryo pseudoglobulin fraction. In most of the proteins studied the concentration/viscosity relationship must have the characteristic curves sharply bent between the steep and flat regions, since it is often difficult to hit upon the concentration which will give a relative viscosity in the optimal region for observation.

As regards the embryological significance of our findings, it may be said that they strengthen previous indications (such as those of Miller and Moore[3], Schmidt[4], Needham and Robinson[5], etc.) of the existence of anisometric particles in developing eggs and embryos. Such particles may well be concerned with the shape changes of neural cell formation. The proteins were extracted from embryos frozen at −77° C. and dried *in vacuo* by methods similar to those of Mirsky[6]. Apart from the behaviour of pseudoglobulin, the anomalous flow of the globulin fraction (consisting largely but not entirely of vitellin) invites the question whether vitellin has not been looked upon in the past too exclusively as a nutritive reserve. Yolk-platelets of amphibia were stated long ago by Radlkofer[7] to show weak birefringence. We hope in due course to publish a complete account of the foregoing experiments and to continue the examination of the viscosity of protein solutions both from embryonic and other sources, on which so much remains to be done.

[1] Edsall and Mehl, *J. Biol. Chem.*, **133**, 409 (1940).
[2] Robinson, *Proc. Roy. Soc.*, A, **170**, 519 (1939).
[3] Miller and Moore, *Proc. Soc. Exp. Biol. and Med.*, **36**, 835 (1937).
[4] Schmidt., *Ber. Ges. Nat. u. Heilkunde, Giessen*, **17**, 140 (1936).
[5] Needham and Robinson, *C.R. Soc. Biol.*, **126**, 163 (1937).
[6] Mirsky, *Science*, **84**, 333 (1936).
[7] Radlkofer, "Ü. Krystalle proteinartiger Körper pflanzlichen u. thierischen Ursprungs", Leipzig (1859).

MARINE ECOLOGY AT HULL

INVESTIGATIONS on the ecology of plankton in the North Sea and the relationships between the plankton and the fisheries have been made now for some years at the Department of Zoology and Oceanography at University College, Hull, under the direction of Prof. A. C. Hardy. The results of some of this work have been published elsewhere, but recently Prof. Hardy has started a new periodical for oceanographical investigations undertaken by the Department. This is entitled the *Hull Bulletins of Marine Ecology*, of which Nos. 1 and 2 of vol. 1 appeared in November 1939 and vol. 1, No. 3 in March 1940. The publications to date are concerned with research with the continuous plankton recorder. No. 1, which is by Prof. Hardy, contains an account of the ingenious recording machine and the method of working it, together with a summary of the plan and scope of the survey made with the instrument. A number of collecting lines have been run across the North Sea at regular intervals of time, and No. 2 of the *Hull Bulletins* contains a list of records made from 1932 until 1937.

The idea of the survey is to attempt "to apply methods similar to those employed in meteorology to a study of the changing plankton distribution, its causes and effects". In this respect it has considerable bearing on problems of the economic fisheries, such as the influence of the amount of plankton in any one area and at any one time on the survival of young fish and the movements of shoals of adults. At the same time the collections provide an index of the movements of water masses as indicated by the contained plankton organisms. No. 3, by C. E. Lucas, contains an account of the distribution of the phytoplankton in the southern North Sea in 1932–37 as shown by the continuous recorder. The report is chiefly in the form of data on which comparisons of different years may be based, and interesting differences are already apparent. Any full consideration of the results must, however, naturally await the final working up and correlation of all the material available.

The scheme of research undertaken by Prof. Hardy was ambitious, and he will earn the gratitude of oceanographers for having carried it through with such signal success. The results already published show good prospects that, given the funds and opportunity, the continuous observation of certain aspects of oceanography on meteorological lines is a possibility.

It is most regrettable that the War has brought these observations temporarily to a close, and when times of peace return they should be restarted and extended over even wider areas. The *Hull Bulletins of Marine Ecology* will form an important addition to oceanographical literature ; it would be most unfortunate if, as suggested on their cover, they only formed a completed work of one or two volumes. In welcoming the new serial the hope may, therefore, be expressed that in due course it will become a permanent addition to publications devoted to oceanographical research, for in Great Britain the number of such journals is at present far from adequate.

NATIONAL RESEARCH COUNCIL OF CANADA

THE twenty-second annual report of the National Research Council of Canada for the year 1938–39 includes the report of the president, Major-General A. G. L. McNaughton, together with the financial statement printed both in French and in English. The review of activities of the Council has this year been published separately.

The president's report refers briefly to work in the Division of Biology and Agriculture on difficulties experienced in the curing and transport of 'Wiltshire bacon' intended for the British market, as well as to other researches on the storage and transport of food. A report on the comparative malting qualities of nineteen barley varieties grown in Canada has been issued in co-operation with the University of Manitoba, and improved methods of predicting the malting qualities of new barleys have been worked out so that satisfactory results can be obtained from small samples. Much progress has been made with investigations on the practical applications of plant hormones, and a commercial hormone powder is now on the market. Promising results have been obtained in co-operation with the Central Experimental Farm in producing a hardy, large-seeded perennial forage plant for the drought areas by crossing wheat with wheat grasses. A new apparatus has been constructed for the measurement of gas production of fermenting doughs with the view of improving baking practice.

In the Division of Chemistry, which has been reorganized during the year, tests were carried out in regard to the production in Canada of face-pieces for gas masks, as well as on the construction and testing of gas-mask containers and the production of adsorbent charcoal. The investigation of domestic barks as sources of tanning extracts continued, and a thorough study was made of the factors entering into the preparation from skimmed milk of rennet casein of a quality suitable for the manufacture of plastics, particularly buttons. Tests are being carried out on the treatment of casein to render it suitable for high-speed injection moulding. Progress in work on magnesium products in the laboratory has been so marked that payments to Canadian railways for freight on the products from the co-operative companies' plants each year now amount to almost as much as the total sum spent on the investigation since the work commenced more than twelve years ago. Fundamental information regarding plasticizing agents has been successfully applied to several types of acid, basic and neutral refractory cements, which are now being manufactured commercially. Laboratory work on the production of asbestos fibre for filtration purposes has been completed and filtration tests carried out on the material. A satisfactory laboratory method for the synthesis of organic selenides has been developed, and the value of selenium compounds as anti-knock agents for motor fuels is being investigated.

Work on the snow performance of aircraft skis has continued, and the Council participated in a comprehensive investigation of aviation fuels under the auspices of the Society of Automotive Engineers. Much work was done for Government Departments, especially on aircraft instruments for the Department of National Defence. Models of ships for Government service were tested by naval architects in the model testing basin.

APPOINTMENTS VACANT

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

TEACHER OF PRODUCTION ENGINEERING—The Principal, Dolcoath Technical School, Camborne, Cornwall (July 31).

DEMONSTRATOR (male) in the Department of Physiology—The Medical School Secretary, Middlesex Hospital, W.1.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1939. Pp. 160+7 plates. (Bristol : The University). [206

Freshwater Biological Association of the British Empire. Eighth Annual Report for the Year ending 31st March 1940. Pp. 82. (Ambleside : Freshwater Biological Association.) 1*s.* 6*d.* [246

Ministry of Agriculture and Fisheries. "Growmore" Bulletin No. 3 : Preserves from the Garden. By B. Alice Crang and Margery Mason. Pp. ii+30. (London : H.M. Stationery Office.) 4*d.* net. [246

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1939. Pp. iv+630+4 plates. (London : H.M. Stationery Office.) 15*s.* net. [256

The Lister Institute of Preventive Medicine. Report of the Governing Body, 1940. Pp. 32. (London : Lister Institute.) [276

Ministry of Home Security. Air Raids : What you must Know, What you must Do. Pp. 64. (London : H.M. Stationery Office.) 3*d.* net. [27

Other Countries

Canada : Department of Mines and Resources, Mines and Geology Branch : National Museum of Canada. Bulletin No. 94 (Anthropological Series No. 25) : Lawson Prehistoric Village Site, Middlesex County, Ontario. By W. J. Wintenberg. Pp. iv+104. 25 cents. Bulletin No. 95 : Annual Report of the National Museum for the Fiscal Year 1938–39. Pp. 24. 10 cents. (Ottawa : King's Printer.) [176

Canada : Department of Mines and Resources : Bureau of Geology and Topography, Geological Survey. Memoir 219 : Halfway Lake—Beresford Lake Area, Manitoba. By C. H. Stockwell and C. S. Lord. Pp. vi+68+1 plate. 25 cents. Memoir 220 : Mining Industry of Yukon, 1938. By H. S. Bostock. Pp. iv+18+3 plates. 10 cents. (Ottawa : King's Printer.) [176

Commonwealth of Australia. Thirteenth Annual Report of the Council for Scientific and Industrial Research for the Year 1938–39. Pp. 110. (Canberra : Commonwealth Government Printer.) 4*s.* 6*d.* [206

Proceedings of the United States National Museum. Vol. 88, No. 3078 : Trematodes from Fishes mainly from the Woods Hole Region, Massachusetts. By Edwin Linton. Pp. 172+26 plates. (Washington, D.C. : Government Printing Office.) [206

Southern Rhodesia Geological Survey. Short Report No. 31 : Geological Report on the Norton Gold Belt. By R. Tyndale-Biscoe. Pp. 10. (Salisbury : Government Printer.) [246

The South African Journal of Science. Vol. 36 : Being the Report of the Thirty-seventh Annual Meeting of the South African Association for the Advancement of Science, East London, July 3–8, 1939. Pp. xx+578. (Johannesburg : South African Association for the Advancement of Science.) 30*s.* net. [246

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1939. Pp. 38. (Entebbe : Government Printer.) 2*s.* [246

Nyasaland Protectorate. Annual Report of the Forestry Department for the Year ended 31st December 1939. Pp. 28. (Zomba : Government Printer.) [246

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 30 : Biological Notes on Indian Parasitic Chalcidoidea. By Dr. Hem Singh Pruthi and M. S. Mani. Pp. 50+22 plates. (Delhi : Manager of Publications.) 3.6 rupees ; 5*s.* 6*d.* [246

Report of the Botanical Survey of India for 1938–39. Pp. 14. (Calcutta : Government of India Press.) [246

Memoirs of the Geological Survey of India. Vol. 75 : A Catalogue of Meteorites, with Special Reference to Indian Falls and Finds and to Specimens in the Indian Museum, Calcutta, as on August 1st, 1939. By Dr. A. L. Coulson. Pp. iv+346+6 plates. (Calcutta : Geological Survey of India.) 4.8 rupees ; 7*s.* [246

Memoirs of the Royal Asiatic Society of Bengal. Vol. 12, No. 2 : The Alleged Pugnacity of the Swordfish and the Spearfishes as shown by their Attacks on Vessels. (A Study of their Behavior and the Structures which make possible these Attacks.) By E. W. Gudger. Pp. 215–315+plates 3–9. (Calcutta : Royal Asiatic Society of Bengal.) 7.14 rupees. [246

Year-Book of the Royal Asiatic Society of Bengal for 1939. Vol. 6, 1940. Pp. 208. (Calcutta : Royal Asiatic Society of Bengal.) 4.14 rupees. [266

Annual Report of the Indian Central Cotton Committee for the Year ending 31st August 1939. Pp. iv+192. (Bombay : Indian Central Cotton Committee.) 2 rupees. [266

Summary Proceedings of the Forty-first Meeting of the Indian Central Cotton Committee, held on the 19th and 20th January 1940. Pp. 60. (Bombay : Indian Central Cotton Committee.) 1 rupee. [266

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